Service Manual of Marine Gearbox Model GW Series

® Hangzhou Advance Gearbox Group Co.,Ltd

(Hangzhou Gearbox Works)

FOREWORD

The marine gearbox GW series manufactured by Hangzhou Advance Gearbox Group Co., Ltd. The People's Republic of China, has been approved by the classification societies such as ABS, LR, GL, CCS etc. with good selling at home abroad.

Thanks to their compact design and wide matching range, GW gearboxes' rated input speed is 400-1800r.min^{-1}, ratios 2:1～6:1 and rated transmission capacity (N/n1) 0.257～9.25 kW/r.min^{-1}.

GW gearboxes have 6 series, each of which has 10 models. The GWC, GWD, GWS and GWH have the function of reverse and reduction, and the GWL and GWK without reversing function. Input and output shafts can be arranged coaxial or offset (vertically, horizontally or diagonally). The gearboxes have adapted to combined design, and all running parts have been carefully designed and machined to the highest standards for less wasted fuel, smooth operation which can be fitted to most engine models.

Gearbox controller can be selected pneumatical or electrical operation with manual emergency control device. Gearbox and engine are connected by a highly flexible coupling which may be ordered on request. In generally a stand-by pump set should be prepared. When fitting to the engine, please refer to the main transmission data and the instructions in the manual. For special requirements, contact with sales and design departments.

A thorough understanding of this manual will result in lengthy and satisfactory service from the gearbox, please carefully read the manual before putting the gearbox into operation and install, operate and maintain according to stipulated requirements in the manual.

Important Note:

The gearbox can not be held responsible for torsional problems arising from the drive system. We therefore recommend that a calculation and adjustment for the vibrational data of the ship's entire drive system should be performed including the torsional compatibility of the gearbox.

No liability is accepted for the gearbox damage arising from wrong matching, operating or other parts of the drive system caused by such vibrations.

The manual is applicable to the standard gearbox version. Variations are possible on special customer requirements.

Technical modifications revised.

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Ⅰ. List of Technical Data

1. General data

Engine manufacturer:

Engine type:

Engine output : P = kW

Output speed: n = r/min

Direction of engine rotation (facing the flywheel):

Classification society:

Shipyard:

Hull no:

2. Gearbox data

Product no:

Type and size:

Input speed:

Gear ratio:

Control type:

Oil grade:

SD/CC30 or SAE30 (in summer of the torrid zone for SD/CC40 or SAE40

Lub. Oil quantity:

Max. lub. Oil temperature 80℃

Cooling water inlet temperature ≤32℃

Cooling water inlet pressure ≤0.6MPa

Cooling water requirement	m^3/h
Reversing time	t ≤15s
Mechanical efficiency	η ≥97%
Rated propeller thrust	Ps = N
Permissible angle of inclination:	Longitudinal 10°, Transverse 15°
Overhaul:	10000h
Net weight:	1

3. Technical documents (standard)

Service Manual

Gertificate

Assembling drawing

Outlook and installation drawing

Part list

List of torque vibrational data

Diagram for clutch thermal load limited (Switching frequency)

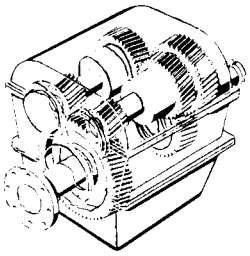
Maintenance Card

II . Description of Gearbox

Marine Gearbox GW series cover six models. There are the GWC, GWD, GWH reverse reduction gears and the GWL and GWK reduction gears (without reversing function). The six models differ as follows:

GWC design

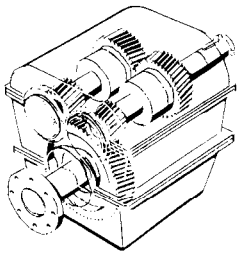
The GWC reverse reduction gear has a primary stage, a reduction stage and a reverse stage. Input and output are coaxial and have same sense of rotation.



GWC

GWD design

The GWD reverse reduction gear has no primary stage but a reduction and a reverse stage, either one of the clutch shafts is driven directly. Input and output are diagonally offset and have opposite sense of rotation.

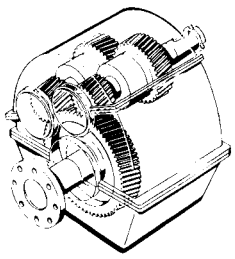


GWD

GWS design

As the GWD model, the GWS reverse reduction gear has no primary stage, but a reduction and a reverse stage.

Input and output are vertically offset and have opposite sense of rotation.

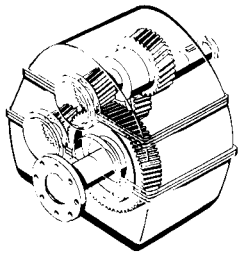


GWS

GWH design

The GWH reverse reduction gear, as GWD and GWS, has a reduction and a reverse stage, but no primary stage.

Input and output are horizontally offset and have opposite sense of rotation.

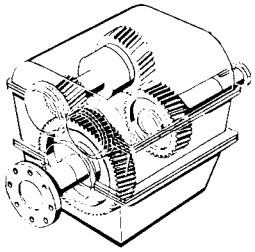


GWH

GWL design

The GWL reduction gear without reverse function corresponds to the GWC model in that it has a primary and a reduction stage.

Input and output are coaxial and have the same sense of rotation.

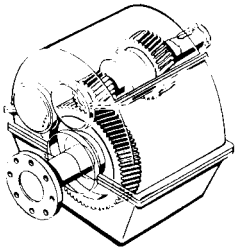


GWL

GWK design

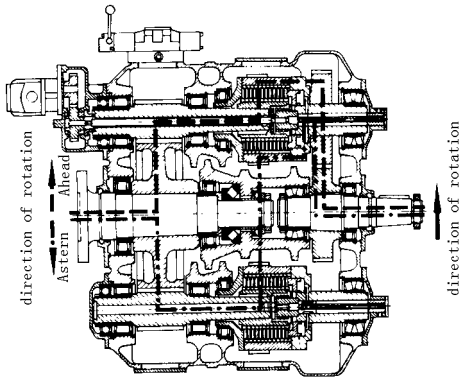
The GWK reduction gear has no reverse function and is of single stage design.

Input and output are vertically offset and have opposite sense of rotation.

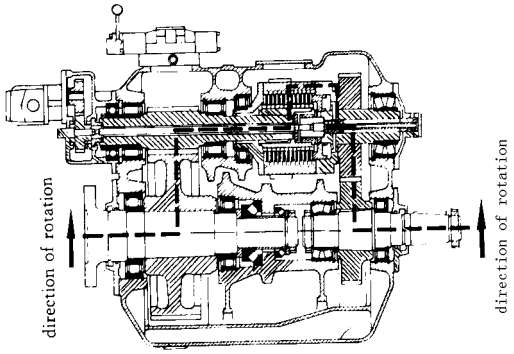


GWK

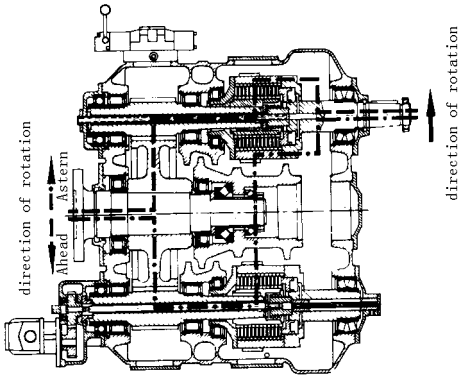
Power flow and shaft rotations for GWC (Fold out section)



Power flow and shaft rotations for GWL (Fold out section)



Power flow and shaft rotations for GWD (Fold out section)



Ⅲ.Instructions

1. General Information

The gearbox is delivered without oil.

The gearbox is protected internally with preservation oil, effective against corrosion for a period of six months when the gearbox is stored in a dry area at an even temperature.

The gearbox is painted externally. Flanges, shaft ends and flanging surfaces outside the gearbox have a preservation paint.

The connections for the air pipes, oil tubes and water pipes to be assembled at the site are sealed by means of blanking flanges or blugs.

Pipelines, pipe connections etc., to the gearbox which have to be installed, modified or renewed after having left our works, must be carefully acidified and cleaned off any obstructions before they are mounted.

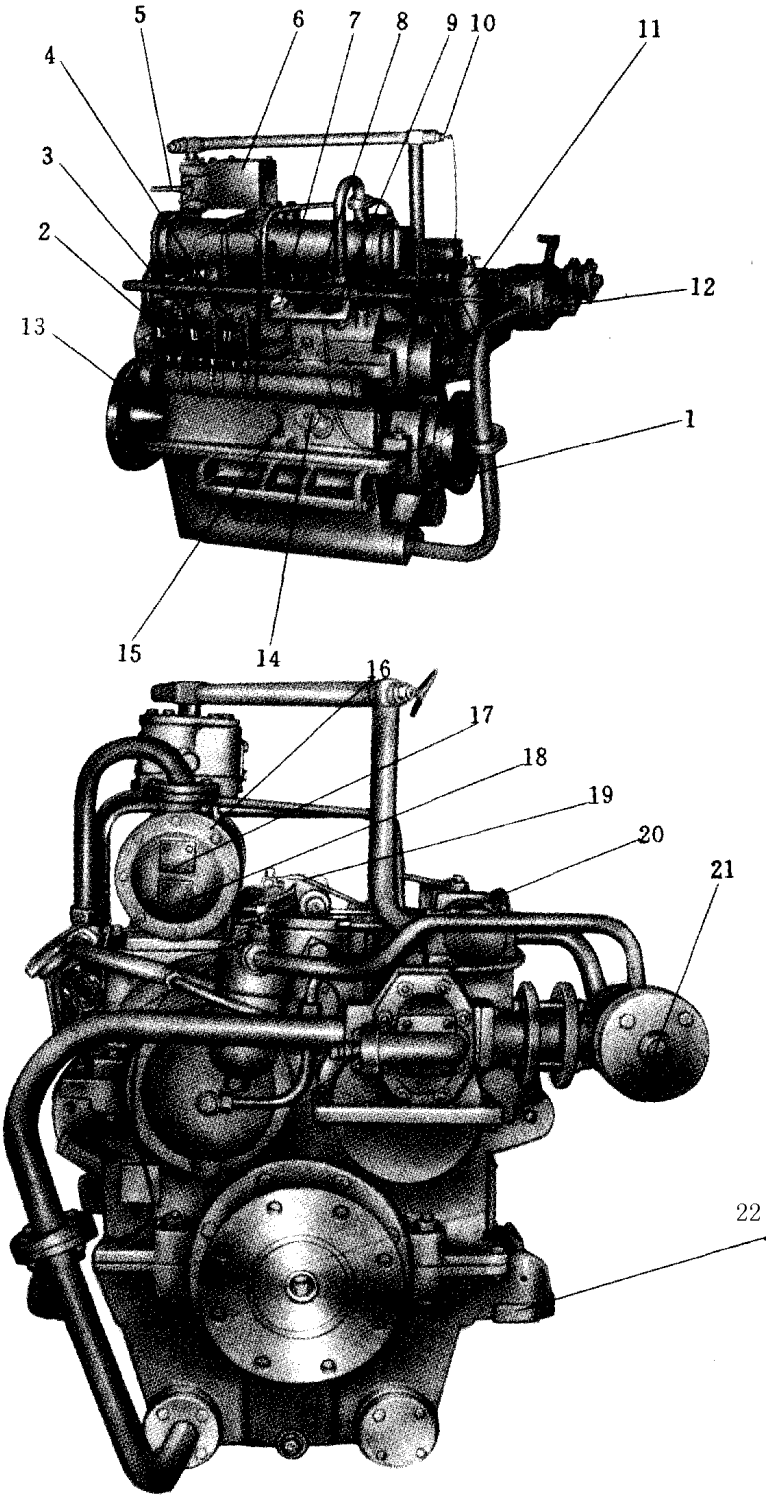
The direction of rotation is shown by an arrow.

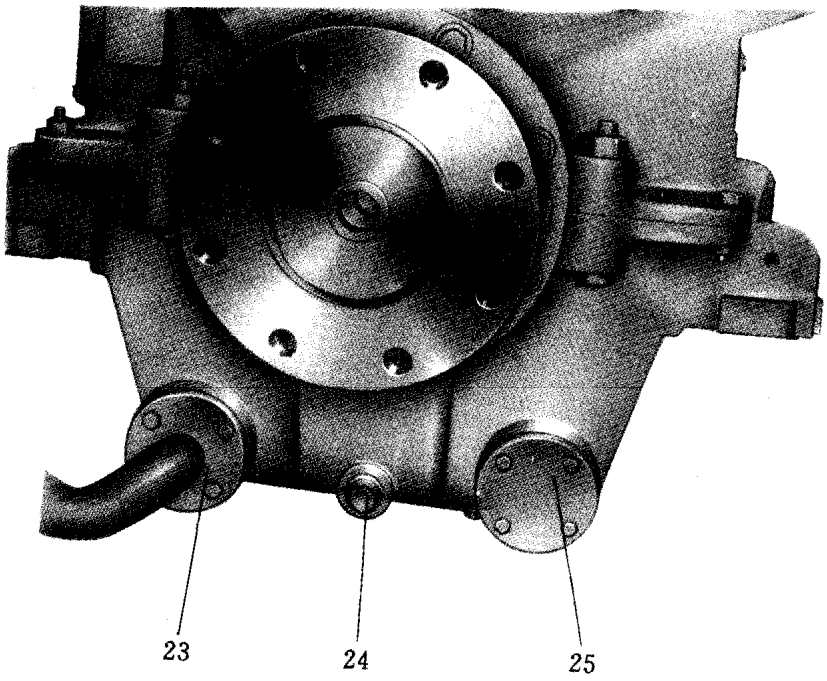
Intermediate Storage

If the gearbox is stored outside, it must be protected from the atmospheric conditions by a protective cover or canopy.

Our liability is invalid when the gearbox is opened without our authorization.

2. Instruction

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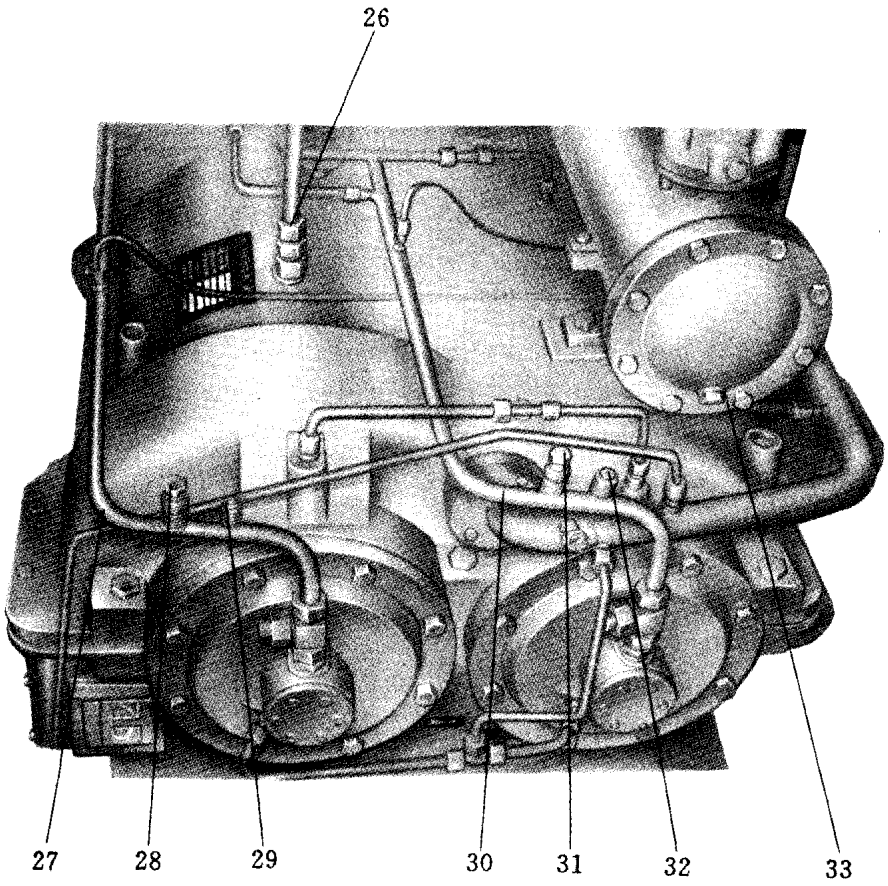
26
27
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32
33

1. Output shaft

Align the gearbox acc to the requirements, then fasten the output flange and the propulsion flange with reamer bolts.

2. Pressure switch

When the lub. Oil pressure reduces to 0.04MPa, the switch is on.

3. Pressure switch for ahead

When the working oil pressure reduces to 1.5MPa the switch is on.

4. Pressure switch for ahead

When the working oil pressure reduces to 1.5MPa, the switch on.

5. Shift handle for lub. Oil filter.

(1) When gearbox running, the handle is placed horizontally.

(2) It is necessary to turn the handle 90° clockwise, while the gearbox is running continuely, the oil flows directly into the system. After cleaning the filter, be sure to return the handle in horizontal position.

6. Lub. Oil filter

Periodically clean the filter acc. To the maintenance instructions.

7. Pressure gauge

Indicate working oil pressure.

8. Oil temperature indicator

Show the oil temperature.

9. Pressure gauge

Indicate lub. Oil pressure.

10. Temperature switch

When oil temperature reaches 72～75℃, the switch is on.

11. Working oil filter

Be cleaned regularly acc to the maintenance instructions.

12. Oil pump (with pressure limiting valve)
13. Input flange

Special order acc. To differential types of high flexible couplings.

14. Oil filler neck with sleve

Fill oil into gearbox from here.

15. Dipstick

Periodically check oil level acc. to the maintenance instructions.

16. Cooler
17. Water inlet
18. Water outlet
19. Controller

Pneumatic or electrical controller are available in required.

(1) When use pneumatic controller, the air pressure is 0.5～1MPa.

(2) When use electrical control, the voltage: D. C. 24V Permissible voltage fluctuation: ≤15%

20. 2-stage control valve

The valve regulates initial pressure, working pressure, pressure raising time.

21. Non-return valve

From here to connect stand-by pump set.

22. Installation bracket
23. Pump suction
24. Drain plug
25. Stand-by pump suction

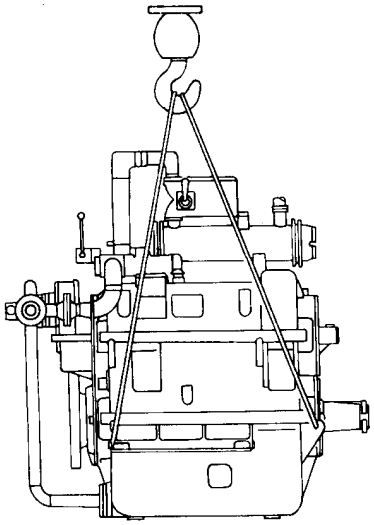
Connect to stand-by pump pipes.

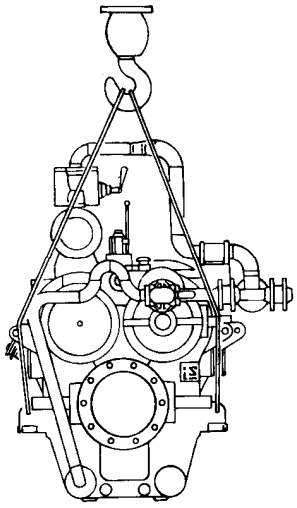
26. Back pressure valve

    Regulate lub. Oil pressure.

27. Working oil pipe, ahead
28. Spare adapter (M14×1.5)
29. Spare adapter (M10×1)
30. Working oil pipe, astern
31. Spare adapter (M14×1.5)
32. Spare adapter (M10×1)
33. drain plug for cooler

Ⅳ. Mounting





Transportation

The gearbox is suitably suspended on cables for transportation.

Therefore, all cables taking the gearbox weight should be clear of the fittings.

Slowly lift the gearbox and place in position.

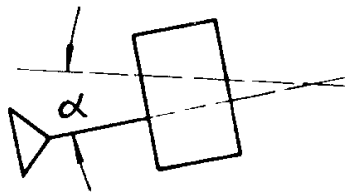
The lifting lugs on the upper part of the gearbox serve only to remove the upper section. To lift the complete gearbox the transportation lugs are to be used.

To avoid accidents cables are to be used with shackles.

Installation in the engine room

The aligning screws are to be inserted into the tapped holes in the mounting bracket. Via the aligning screws the gearbox rests on the top plates.

Maximum permissible permanent installation angle fore and aft $\alpha = 5^\circ$



The foundation

In order to facilitate the changing of oil and washing-out of the gearbox, the foundation has been constructed so that there is sufficient space for the installation of an oil-collector below the drain plug.

The fitting of couplings

If couplings have to be fitted onto the gearbox input shafts, the calibers of the bore holes in the coupling hubs have to be adapted to the diameters of the shaft ends according to our assembly drawings. When the couplings are fitted the hub must be

heated. For this, the temperature of the hubs has to be 40° higher than that of the shaft, in the case of a taper fit. Thus driving-on shocks or impacts will be avoided and the gear wheels protected.

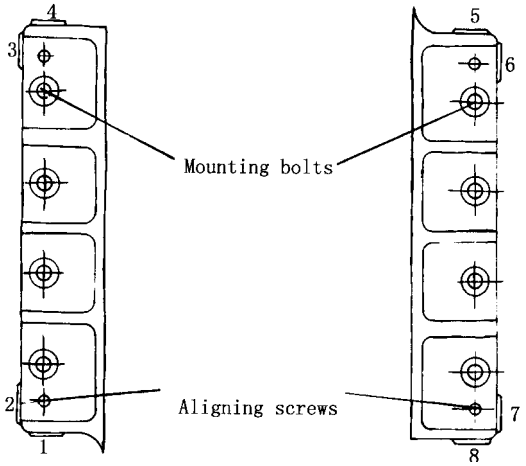
Gearbox is fixed to the foundation

If the gearbox is fixed to the foundation with bolts, then all bolts must be reamed bolts. The holes are pre-bored and must have a larger clearance for together ream.

Use bolts of strength specification 8.8

Tensile strength: 758N/mm^2

Ductile strength: 630N/mm^2



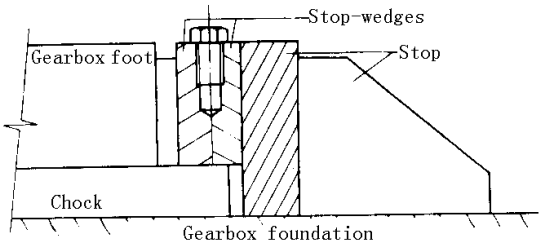
1 - 8 Stopper faces (machined)

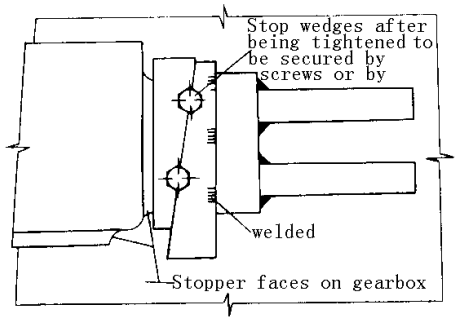
Foundation Drawing of Gearbox

If the gearbox is mounted and fixed with stoppers against the foundation, normal bolts can be used.

The sizes in the Assembly Drawing can be taken for clearance holes. The bolts can now be chosen to fit. 8 stoppers must be used, the principle of which can be seen on the drawings.

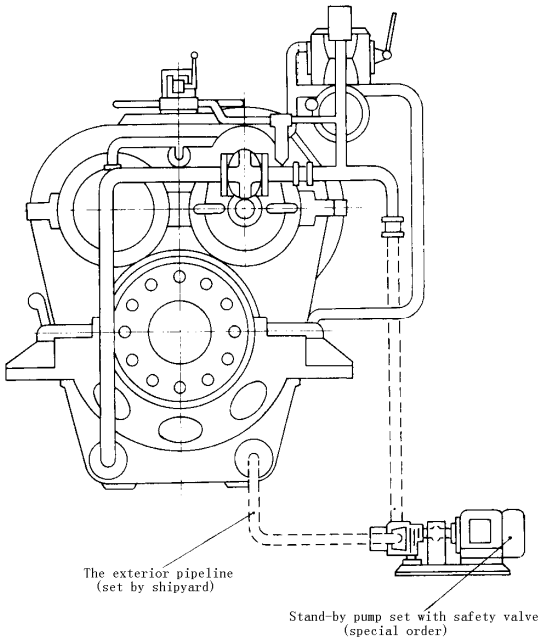
The required chocks must conform to the classification societies' requirements.





Stand-by pump

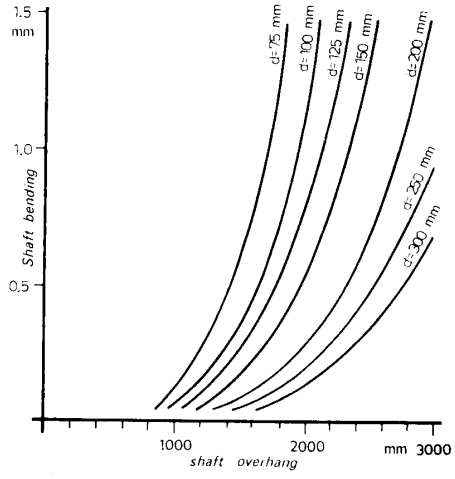
In the case of an installation with a separate stand-by oil pump, the oil must be pumped through the system for approximately 2 hours before the first start. For this a close meshed strainer must be inserted at the oil inlet to the gearbox, in order to catch dirt particles coming from the pipeline system installed after delivery. If the diameter of the pipe exceeds NW 25 (1″), the strainer has to be supported by a perforated disc of 2mm thickness with holes of approximately 8mm diameter, in order to prevent the strainer from being crushed and getting into the interior pipeline system, which may happen if the dirt accumulation is too heavy. During this pump test, the exterior pipeline system can be checked for leaks.



Ⅴ. Gearbox Alignment

The propulsion unit shall only be aligned when the vessel is afloat and it is definitely ensured that it is not in contact with the ground.

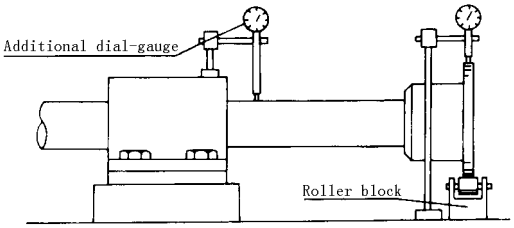
The completely assembled propeller shaft shows a deflection between the supporting bearing and the flange. The extent of the deflection in relation to the shaft



overhang and diameter can be seen in the diagram. This deflection is to be compensated.

Bending checking on the propeller shaft

The right illustration shows how the deflection is eliminated for gearbox alignment. A roller block is placed underneath the end flange of the propeller shaft and raised by the amount of deflection ascertained.

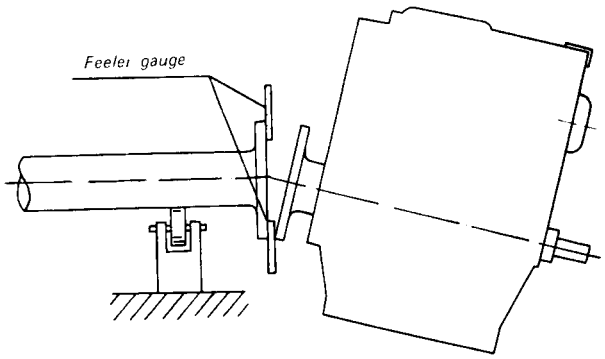


There are, however, cases where the free end of the propeller shaft due to additional loads is bent more than is required by natural deflection. In this case, an additional dial gauge can be installed near the bearing which indicates the amount of lift required at the shaft end to ensure that the shaft in the bearing is evenly raised.

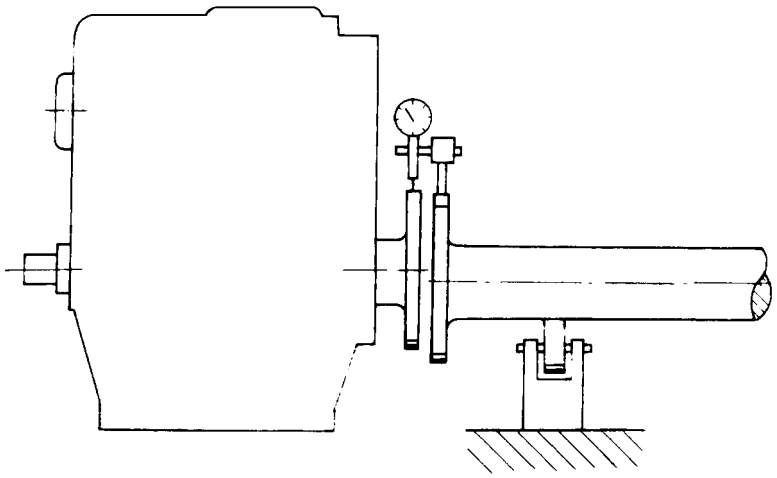
The reading thus taken at the shaft flange dial gauge is twice the value of the actual deflection. Raising the roller block by half of this value corrects exactly the position of the propeller shaft flange.

Aligning the gearbox axial parallelism

The illustration shows how this is to be done with the help of feeler gauges. It is important for this measurement that the shafts be turned in one direction only. The accuracy of axial parallelism should be no more than 0.01mm for 100mm of flange diameter.



Aligning the gearbox axial displacement



When the gearbox is arranged parallel to the propeller flange, the axial displacement is to be aligned.

In the illustration it shows the procedure to be followed. Here, turning must also be in one direction only. A dial gauge can as well be mounted in a suitable manner on the propeller shaft flange to ensure correct and true measurements.

Propeller shaft flange and gearbox flange are turned simultaneously so that the dial deflection can be read. The required accuracy is 0.025mm (i.e. 0.05mm deflection on the dial gauge).

Align gearbox and engine acc to the requirements of the highly flexible coupling.

Compensation for thermal expansion

Since as a rule gearboxes are aligned when in cold condition, the amount of vertical thermal expansion between the support and propeller flange center must be compensated for. The following diagram shows the degree of compensation required for various types and sizes of the GW gearbox series. With the help of the aligning screws on which the unit rests during aligning the gearbox is raised by the dimension indicated, to bring it to the position which exists when the gearbox has reached its operating temperature.

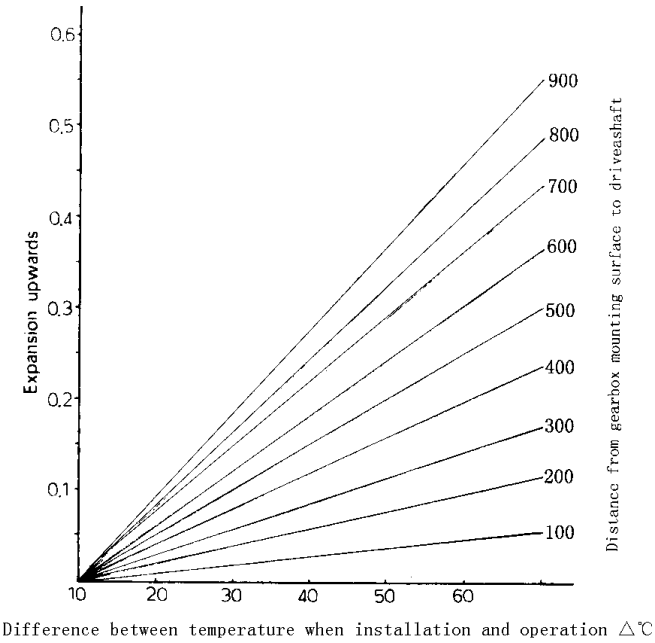
The Compensation diagram considers not only the thermal expansion but also the bearing play.

If tanks are to be found underneath the gearbox foundation, which have varying temperatures during the ships operation, the diagram is not suitable.

The Compensation diagram takes into account only the position changes of the gearbox shafts.

Deflections for the engine are to be observed.

Compensation diagram



Ⅵ. Gearbox Control and Remote-Control

1. Control types

A dependable remote control is of great importance for a ships drive system.

The gearboxes of the GW Family are supplied, as standard, with a pneumatic gearbox switch.

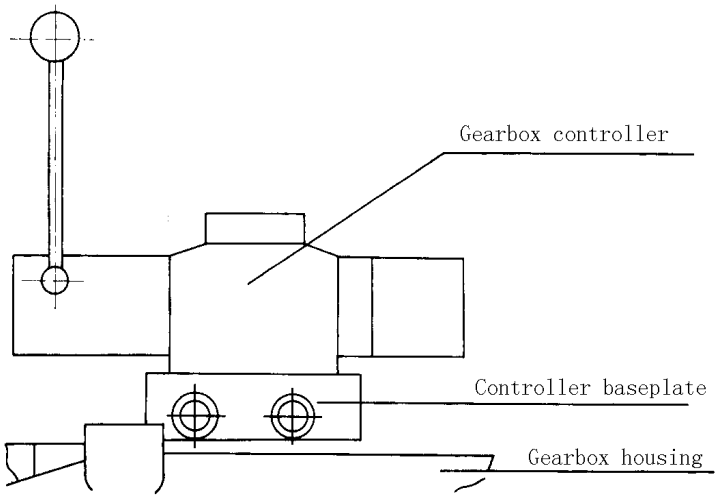
Electrical gearbox controllers are available. The gearbox controllers, whichever type of operation, have exactly the same base plate connections.

To this base plate are all pipelines connected.

The base plate is separately screwed to the gearbox housing.

Through having separate base plates, the replacement of a controller can also mean changing the type of operation without having to change the pipe work system.

Pneumatic gearbox controller



2. Requirements of the control system

Even through the running of the motor governor, gearbox coupling and, if supplied, shaft brake is difficult, it is necessary to perform the following steps to check the system:

The switching sequence for all switching systems should conform to the following specifications.

Bridge control

Controller positions Full Ahead onto Astern

or

Full Astern onto Ahead

or

Full Ahead onto Full Astern

or

Full Astern onto Full Ahead

Sequence

1. Control unit onto low speed

Let the propeller shaft speed drop to a minimum of 60% of the rated speed

2. Coupling in zero position

2.1 Propeller shaft brake engages

2.2 Propeller shaft stops

2.3 Open propeller shaft brake

（In case without brake the controller should be retained at zero position for approx. 2～3 sec.）

3. Engage coupling

4. Retain switch position for approx. 1 sec.

(In case without brake, the controller should be retained at engaging position for approx. 1.5～2 sec. then increase speed).

5. Increase speed

The control system must be carefully maintained.

Any faults must be immediately repaired. The control units must be handled very carefully.

Switching rate of the Gearbox

When the switching rate is high and or if engine speed is high when switching, the diagram “Engagement speed/Number of Engagements” must be considered.

The diagram is based on the heat regenerating ability of the multiple disc clutch and determined according to the service condition as specified in the order. It shows the admissible number of engagements in relation to the engagement speed.

The “Number of engagements/minute” is to be understood to be a uniformly divided switching rate per minute. “Engagement speed” is the switching is initiated.

A copy of the diagram must be available at the bridge.

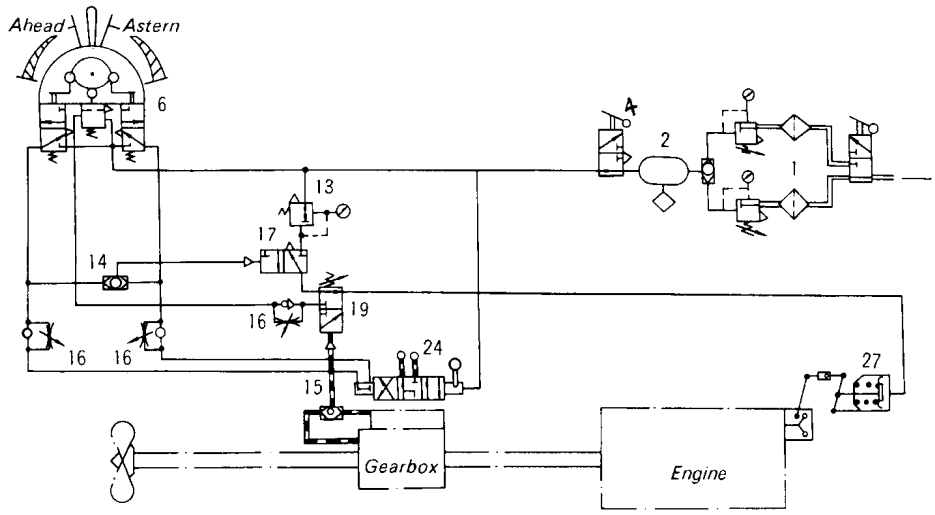
3. Pneumatic remote control and design example

When the gearbox is equipped with the standard controller, the remote control is via pneumatics.

When planning the remote control system attention should be payed to:

The engine speed when reversing should not amount to more than 60% of the motor rated speed. An agreement between the supplier of the control system and Hangzhou Gearbox Works must be made for the requirements of the “Crash-Stop” man oeuvre design.

Design example for the pneumatic control of the ships drive.



1. Pressure reducing station
2. Air reservoir
4. Stopcock

6. Control valve

13. Pressure reducing valve

14. Double non-return valve

15. Double non-return valve for oil

16. Non-return choke valve

17. 3-way valves

19. 3-way valve, adjustable

24. Multi-way valve, hydraulic-pneumatic

27. Control unit

Circuit diagrams for systems with multiple control points, as for ships with multiple systems, can be provided.

Description for a design example of a pneumatic ships propulsion control.

The example shows the pneumatic remote operation consisting of motor, reversing gearbox and fixed propeller, within the ships drive system. With the single-lever operation of the control valve 6, the desired value for the motor speed and the directional rotation of the propeller wiz be given.

The control air supply is via a pressure reducing station 1, whereby the doubled supply of air is filtered and from 3 MPa to the operating pressure of 0.6 MPa is reduced. In the air-reservoir 2 the air is stored and if necessary, the water drained off.

The control air desired value is over control valve 6 which then goes to control unit 27 and then the pneumatically/mechanically multi-way valve 24 for the motor and gearbox to be adjusted into the required operating condition. Also dependent on the switching oil pressure of the clutches can only be changed at a low motor speed. The motor speed is raised slightly by the combination of units 13, 17, 19 and 14 when the

gearbox is in a reversed procedure, so that the motor governs the propeller inertia.

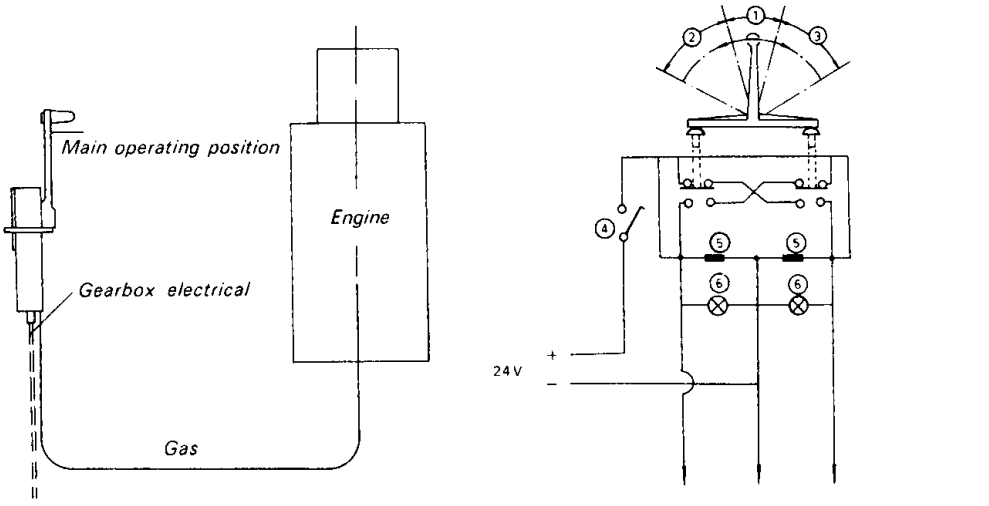
4. Electrical remote control design example

When the gearbox is equipped with the electrical controller, the remote control is via electrical system.

When planning the remote control system attention should be payed to:

The engine speed when reversing should not amount to more then 60% of the motor rated speed. An agreement between the supplier of the control system and HC must be made for requirements of the “Crash-Stop” manoeuvre design.

Wiring diagram of the main operating position.



1. Stop 2. Ahead 3. Astern 4. Main selector

5. Erase link 6. Control lamp

Ⅶ. Initial operation

All gearboxes are given a test-run and checked by the manufacturer in the workshops. The control units and control valves are all adjusted in the workshops.

By delivery the gearbox is without oil and is internally protected by a preservation oil. This oil has the quality to mix without any problem or detriment to the gearbox oil.

Turn the engine and propeller shaft, with the unit in “Neutral” position.

The sequences of initial operation describe in brief as follows:

1. Fill the gearbox with lub oil acc to oil specification table, a meshed strainer should be used to avoid foreign matter entering into.

Check whether the lever of the filter is put to “working” position, and the gauges, as well as pipelines are correctly mounted.

2. In the case of an installation with stand-by pump, at first turn on the stand-by pump for reading on lub oil gauges (If there is no reading on the gauges within one minute about, the stand-by pump should be stopped for inspecting), running for half an hour (a little more in winter), then turn off the stand-by pump and start the engine.

3. In case of no stand-by pump installation, at first start the engine running at idling speed for reading on oil gauges (If there is no reading on the gauges within one minute, the engine should be stopped for inspecting), running halt an hour (a little more in winter) then engage “Ahead” and “Astern” for a short period.

4. Check the oil level.

The oil level can be taken from the dip-stick. The dip-stick has marks for “stationary” and “running”. When taking the oil level reading with a “stationary” gearbox, the oil level must be between the marks “stationary” and with a “running” gearbox between the “running” marks.

5. The gearbox should be slowly run-in until the operating temperature is reached under a partial loading. Then all joints and connections of the oil pipelines should be checked for leakage and if necessary, re-tightened. The cooling system must be adjusted so that the operating temperature is kept constant at a full load. After a total 10 operating hours the foundation bolts must be checked and, if required, tightened. All renewed pipe connections must also be checked.

Ⅷ. Lubrication and Oil pressure instructions

1. Lubrication oil specifications

Following lubrication oil are to the used:

API-Classification: CA, CB, CC

Respectively MIL-L-2104A

Viscosity grade: SAE30

This is mineral oil without an EP additive. This oil brand specification must be strictly adhered to, since GW family gear units, incorporate also multiple plate friction clutches which, in addition to the gearwheels, take part in power transmission.

Extreme pressure additives negatively effect the functioning of these clutches.

Preferred lubrication oils:

Mineral oils of group SOU 63 or HQ-10 GB485-72; HC-11 SY1152-71 (china) are to be used for the running-in and later operations.

Oil group

SOU O Ⅱ s without additives influencing friction and wear.

Viscosity group 63

Viscosity from 50 to 80 cSt corresponding to 6.6 to 10.5E by 50℃

	Firma/Oil Type
FINA	FINA Dorano 30
	FINA Dilano 30
	FINA Stellano 30
	FINA Cirkan 100
	FINA Solna 30
	FINA Purfinaol 30
Fuchs	Renolin LTA 30
	Renolin 20B
Mobil	Mobil D.T.E. Oil Heary
Shell Shell Tellus OIC100	
	Shell Turbo OIT100
	Shell Vitrea OI100
Texaco	Regal Oil R&0 150
	Ursa Oil P 100

2. Rated Values for oil pressure

Switching oil pressure(MPa)	Starting	Normal running
Gearbox oil temperature	15° ～30°	40° ～60°
Idling:		
Pre-Pressure:	$0.3^{+0.15}_{-0.1}$	$0.2^{+0.15}_{-0.05}$
Switch-pressure:	$1.8^{+0.2}_{-0.1}$	$1.8^{+0.2}_{-0.2}$
Rated speed:		
Pre-pressure:	$0.6^{+0.2}_{-0.1}$	$0.6^{+0.15}_{-0.1}$

Switch-pressure:		$2^{+0.3}_{-0.1}$	$2^{+0.2}_{-0.1}$
Lubrication oil pressure (MPa)			
Idling * :	min:	0.04	0.04
	Max:	0.25	0.15
Rated speed:	min:	0.1	0.1
	Max:	0.4	0.3

Switching time of the 2-stage-valve

2.5～3.5 sec 1.5～2.5 sec

* appropriate 1/3 nominal rotation speed

If the actual values differ from the rated values the Service Dept should immediately by informed.

Ⅸ. Maintenance

Daily: Check oil level.

Turn gap-type filter in the switch line 2～3 times.

Check the gearbox for leakages.

Check the oil pressures and temperatures.

Monthly: Clean the gap-type filter.

Clean the lubrication oil filter.

Check the remote control operation.

Check oil for water contact.

Yearly: Check all exterior screw connections.

Check the protection covering of the sea water cooler if used.

Oil change: Under normal service conditions, the first oil change must be after approximately 250 working hours.

Further oil changes must be completed after approximately 2000 service hours, however, not longer than 12 months.

In special conditions consult a mineral oil company.

Before filling with new oil, in accordance with the enclosed lubricant specifications, the gearbox must be cleaned with flushing-oil.

Ⅹ. Special Notes

1. Monitoring equipment

If monitoring equipment has been installed by the shipyard and maximum permissible value sensors (pressure and temperature controls) fitted then the following information must be observed:

When engaging the clutches the total oil quantity. For a short period, is required to fill the clutch cylinder. This produces that for a short period there is no oil pressure. The warning or cut-off system manufacturer has taken this particular feature into consideration. An override mechanism is included in the warning or cut-off system and conforms to the classification society for maneuver operations.

2. Basic explanation of pumping unit motors

Together the suction and pressure lines may contain no more than four 90° elbows. The maximum suction pipeline length may not exceed 1.5 metres and the pressure line length 2.5 metres.

The electric motors have to be designed for long term operation and conform to the classification rules with consideration of the room temperature. By an unknown room temperature, 45℃ is a good basis. Isolation is of normal design.

None of the motors has an explosions class. The terminal box has the type of enclosure. The motor is normally of construction; spark suppression has not been provided for. Content following is only valid for GW with Segment thrust bearings.

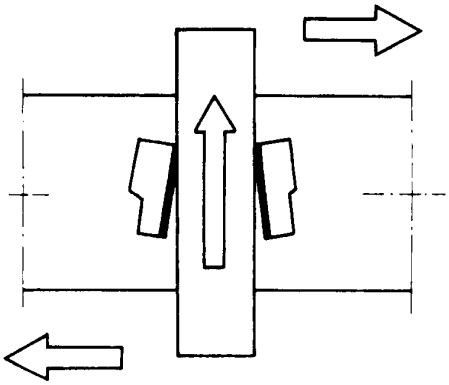
3. Replacement of the segment thrust pads, Output end

After removing the bolts, lift the bearing cover vertically.

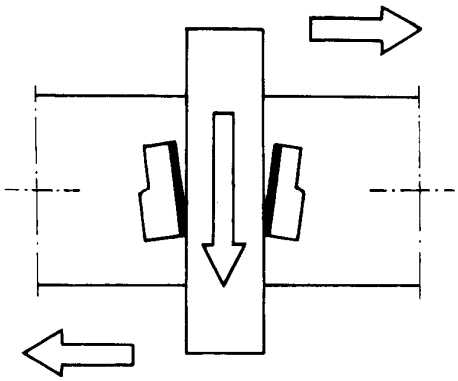
Remove upper part of the radial bearing. Lift the upper part of the supporting disk together with the thrust pads.

Turn the lower part of the supporting disk by means of the holes at the circumference and lift the disk.

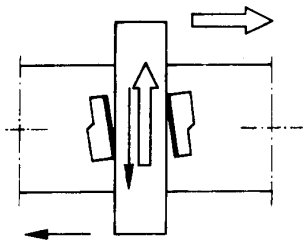
Re-assembling is in the reverse sequence. When installing new pads, take care of the direction of rotation (sketch).



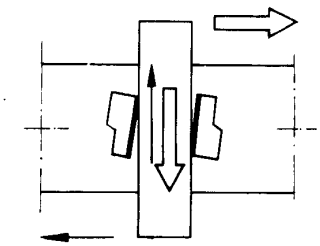
c. p. propeller anti-clockwise rotation



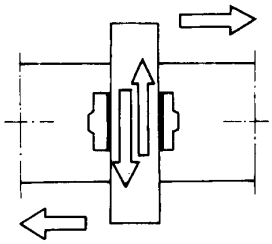
c. p. propeller clockwise rotation



Fixed propeller
anti-clockwise rotation

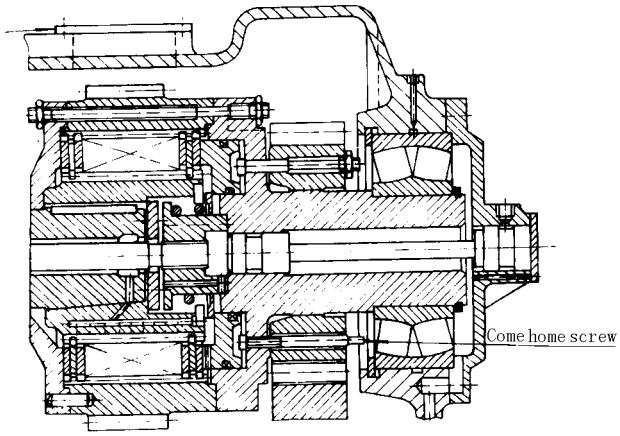


Fixed propeller
clockwise rotation



c. p. propeller and
reversible engine

4. Emergency control of the gearbox



If for any reason the hydraulic control of the gearbox is not possible, then there is always the possibility to block the clutch mechanically.

Remove the inspection hole cover (part. 141) of the upper section of the housing. Remove the locking device of the emergency screw and firmly tighten. Fix the inspection hole cover by means of the screws. The gearbox is now ready for emergency operation.

Leave the gearbox switch in the stop position when in emergency operation.

When emergency switching, pay attention:

Put the gearbox selector in the stop position after the unit stands still.

Add filling with lub oil, the oil level must be the mark “stationary”.

The engine speed is at 60% or less of the rated speed.

Regularly inspect the temperature on housing surfaces where the hearings were fixed inside.

5. When taken in tow:

When the ship is being towed and therefore the gearbox is being driven by the propeller the lub oil supply must be assured. (The stand-by pump must be running and the oil pressure existing).

In case of no stand-by pump installation, make the intermediate shaft disengaged by means of brake installed on boat tailshaft or other measures.

6. Sealing strips

1. General Information

It is absolutely necessary to observe, that the colour marking on the side of the sealing strip lies on the bottom of the sealing strip groove. When the sealing strip is incorrectly inserted with the fabric side to the shaft can this fabric sealing strip be damaged, thus is the sealing inoperative.

If there is no colour coding then the assembly is arbitrary.

To cut the sealing strip a good sharp knife is required. The cut must be at right-angles to the length.

2. Measuring and fitting

The measurement of the sealing strip must be done with great care.

There must exist a slight compression between the two butting ends so as to give a good seal.

When the sealing strip is measured for separable parts the amount that stands “Proud” of the joining surfaces, must be equal. The amount that the sealing strip is compressed can be seen in previous notes.

3. Running-in conditions

The sealing area of the sealing strip must be lubricated before the first run. It must be continuously lubricated to avoid the strip drying up.

When systems have an adjustable speed, the running-in of the sealing strip must always be at the lowest possible speed.

4. Treatment of Sealing Strips

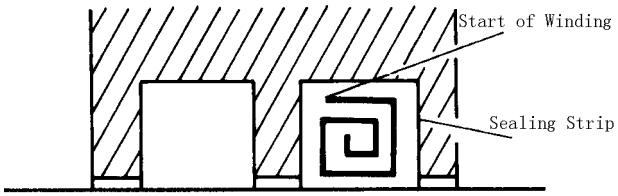
Store in a cool room

During storage the strips must not be exposed to a highly humid atmosphere nor must they come into contact with any kind of liquid.

If the sealing strip is wound then the beginning of the winding must be located away from the shaft.

The start of the winding can be determined by the frontal cut edge.

With plaited sealing strips the assembly is arbitrary.



Apply oil to the slideway of the sealing strip prior to installation.

Press the sealing strip uniformly into the receiving groove suing the handle of a hammer.

After pressing in the sealing strip, cut off the ends at the joint leaving 1.5～2mm proud.

The special notes of the manufacturers are to be observed.

XI. Trouble-Shooting

1. Overheating

Possible cause:	Remedy:
Oil level is too high	Correct oil level
Lubricating oil pressure too low (insufficient cooled oil)	Re-set operating oil pressure to the lowest permitted value
Gearbox is overloaded	Reduce input power

Operating oil pressure is too low (clutch is slipping)	Regulate operating pressure (see 2-stage valve)
Excessive pump pressure	Clean the filter
Oil does not flow back from the outer bearing sides	Installation of end covers or seal covers in such a way that the oil can flow back
Bearings damaged	Replace damaged bearings
Seal too tight	Loosen

2. Lack of oil pressure

Possible cause:	Remedy:
Wrong direction of rotation	After engine rotation or gearbox rotation direction clean filter
Filter obstructed	Refill with oil and trace cause of oil loss
Oil level too low	Change to an oil conforming to the “recommended lubricants”
The viscosity of the oil is too low	See “Excessive gearbox temperature”
Oil temperature too high	Clean suction pipe
Suction pipe obstructed	Replace defective parts or the complete valve
2-stage valve is defective	Renew the pump drive
Pump drive is defective	Install new pump
Pump wear	Adjust remote control operation
Selector position is not correct	Renew oil supply
Wear of the oil supply	Clean quick release valve
Quick release valve does not close	

3. Oil leakage

Possible cause:	Remedy:
Drain plug is not tight	Replace the gasket and tighten drain plug
Dipstick connector not tight	Replace dipstick gasket and tighten
High pressure system leaking	Tighten all fittings
Oil loss through the air-vent	Install a plate under the air-vent
Mating faces of the housings are not sealed	Seal with new compound and tighten all bolts
Leakage of the shaft seals	a) Renew seals b)Install sealing cover in such a manner that the passage is free from the outer bearing side
Oil cooler is leaking	Replace the cooler stem

4. The engine stalls during reversing:

When switching over, the engine threatens to stall, at this manoeuvre the engine must be “caught” by fuel admission so that the power taken from the propeller will not be larger than the engine power at this moment.

Possible cause:	Remedy:
The idling speed is too low	Increase the idling speed
The operating pressure is too high, therefore, engagement is too quick	Reduce the operating pressure to normal value
The gearbox controller is defect (uncon-trolled at flow to one clutch)	Replace gearbox controller
Clutch plates are damaged	Replace damaged clutch plates
The splines of the clutch are damaged	Re-work the splines or renew the part (check at critical speed ranges)

The release springs do not work	Clean the clutch. Replace the springs if necessary
Pistons of the clutch are jammed, seals damaged	Renew damaged seal

5. The propeller does not reach the corresponding speed of the motor.

Possible cause:	Remedy:
Pressure gauge defect, higher pressure shown than in reality	Change pressure gauge and re-adjust oil pressure
Control oil pressure too low	1. Clean filter 2. Check the control operation
Gearbox controller is not exactly in the “Ahead” position	Adjust the remote control operation
Gearbox controller defect	Replace controller
Damaged propeller shaft bearings	Replace worn bearings
Linings of the clutch in the incorrect sequence	Mount the clutch plates correctly
Clutch plates broken	Exchange damaged plates
Sealing rings of the clutch damaged	Replace with new sealing rings
The splines of the clutch are worn	Re-work the teeth or renew the part. Check the installation at critical speed ranges

6. The propeller does not stop turning In “Neutral”

Possible cause:	Remedy:
The vessel is still moving	Wait until it’s at a complete standstill
The propeller is being driven by a current	
Gearbox controller is not directly on the	Adjust the remote operation

"stop" position	
Defect gearbox controller (uncontrolled oil to one clutch)	Replace gearbox controller
Clutch plates broken	Renew clutch plates
Seal damaged, sticking piston	Renew seal
Splines of the clutch damaged	Re-work the teeth or renew the part
Release springs not working	Clean clutch and if required, replace springs

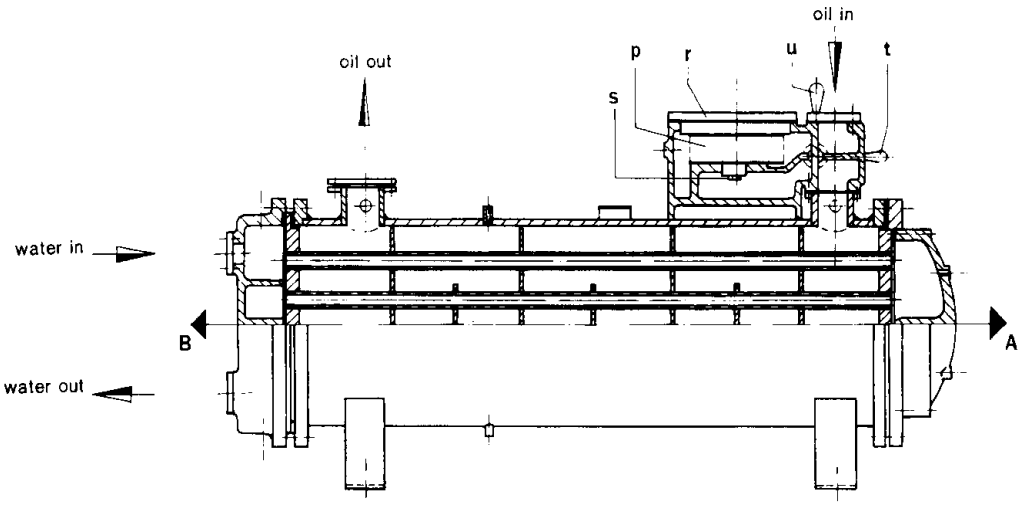
7. Gearbox noise

Possible cause:	Remedy:
Idle speed is within a critical range	Increase idling speed
Gearbox runs within the critical speed range. (The noise is not to be observed through-out the whole speed range)	Avoid running the gearbox continuously in the critical range
Input flange loose	Tighten the flange or replace when damaged
The oil level is too low (Suction noise of the pump)	Correct oil level
Suction pipe not tight. (Pump sucks in air)	Tighten all fittings on the suction line
Filter choked. (Excessive pump pressure)	Clean filter
Pump drive not in order. Gearwheel damaged or loose	Repair damaged parts, or replace
Extreme bearings damaged	Re-align-The whole installation
Gearbox bearings damaged	Renew damaged bearings
Gear wheels are damaged by foreign matter	Grind damaged area and, if necessary, replace the gear wheel
The gear rims are loosened by overloading	Re-tighten the gear rims

Gear wheels are loose on the shaft due to overloading	Re-tighten the wheels
Propeller damaged	Re-set propeller and eventually repair
Output flange is loose	Re-tighten the flange and replace if damaged
Extreme misalignment on the output side of the gearbox	Realign installation

Ⅻ. Standard Accessories

1. Filter and cooler



Cleaning of the filter: After approx. 200～300 hours of operation, the filter package has to be removed and cleaned. With a large dirt accumulation and when on the first run, the filter must be more frequently cleaned. Differential pressure may not exceed 0.2MPa as otherwise the filter package can burst.

Remove the plate “r” with filter cartridge “p”, then remove the nut “s” and the filter cartridge. The filter can be a multi-baged one of which consists of several round disc or a

star-sieve cartridge. The filter web is to be rinsed in an acetone bath and blown out with compressed air.

Care must be taken not to damage the web. After cleaning, re-assemble the filter on the plate “r” and mount into the filter housing.

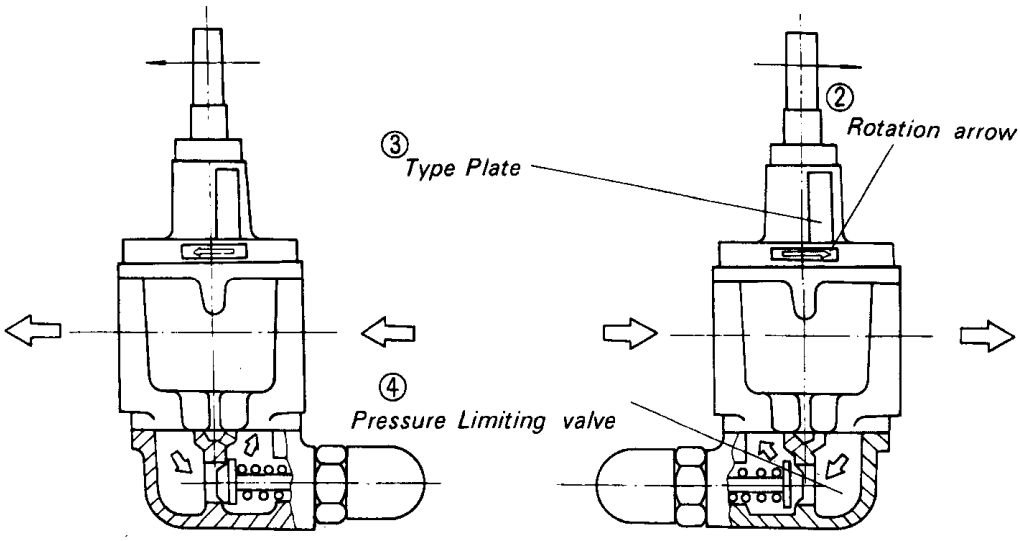
Generally, the filter has to be cleaned when the machine set is stopped.

In special cases, it is allowed for cleaning the filter during the set is running, firstly switch the lever to the “u” position for oil flows directly into the cooler, then clean the filter cartridge. After cleaning, the lever must be switched to the “t” position.

Cleaning of tube bundle:

Water side: After cutting off the water and oil flow, the oil should be emptied at the bottom chamber socket cover. After the removal of the reverse covers the cooling tubes are to be cleaned by means of wire or nylon brushes and the remains blown out with compressed air. The covers can now be re-assembled.

2. Geartype oil pump



Filling: Normally when putting into operation the filling of the pumps is not necessary, but dry operation must be avoided.

Direction of rotation: Pumps must only rotate in the given direction, but it is possible to alter the direction of rotation. To check the direction of rotation the motor can be switched on and off for short periods, only so long as the pump is filled and has no load.

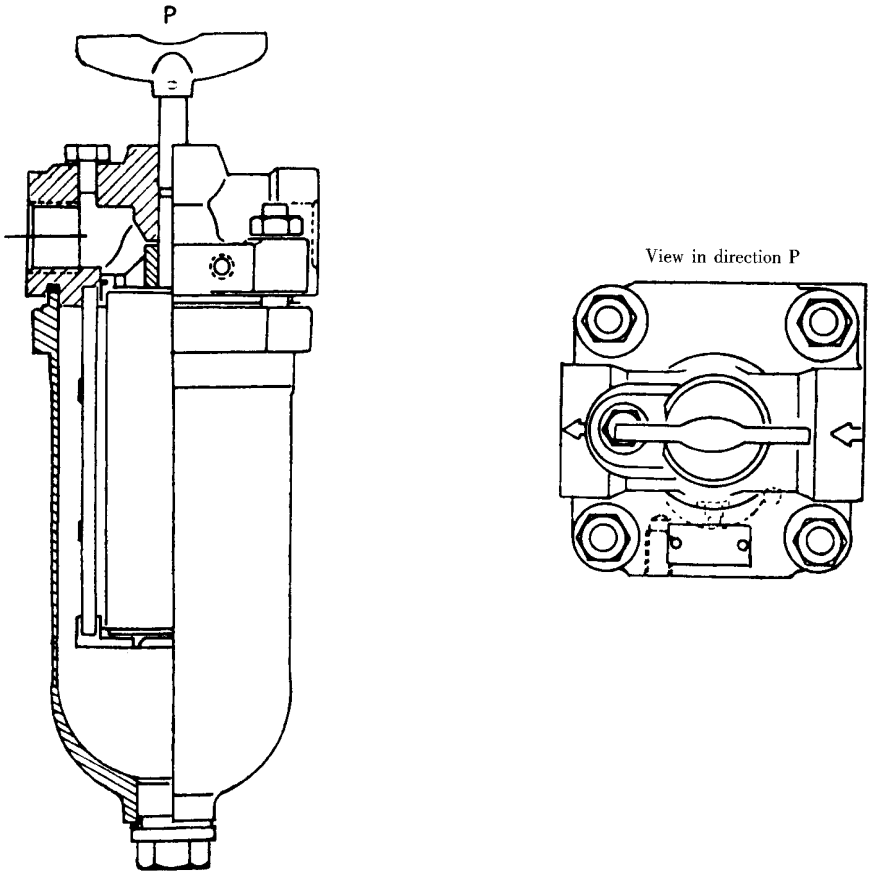
Pressure limited: The pump and hydraulic system have to be protected by the pressure

Limiting valve, when ex-works, the valve discharge pressure set of 2.5MPa, normally without re-adjustable.

Temperature: After having reached the operating values, the temperature of the units especially that of the bearings and shaft seals has to be checked.

Bearing temperatures taken on the surface may exceed the oil temperature by 10℃.

3. Filter for control oil circuit

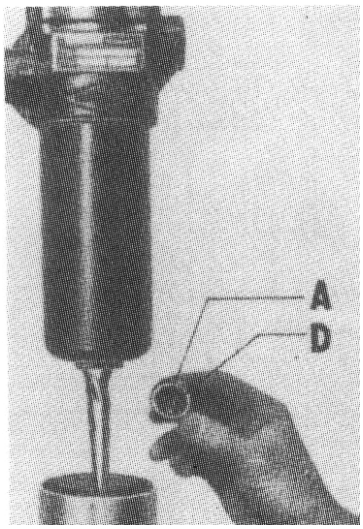


Mode of operation and maintenance

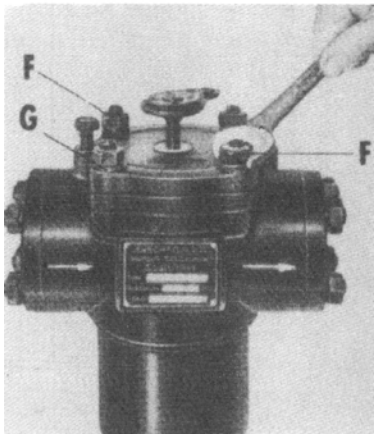
The liquid to be cleaned flows from the outside towards the inside of the filter element, whereby the dirt particles are left on the element. Dirt collects on the filter element and by means of a special unit, operated by turning the T-handle or setting in motion the electrical or hydraulic spindle drive, is scraped-off and allowed to drop into the sediment chamber. This must, from time to time, be drained. No other maintenance of any kind is necessary.

Cleaning instructions:

1. According to operating conditions the filer must be cleaned regularly. It is advisable to clean the filter when new liquid is to be renewed. The pictures show the cleaning procedure.



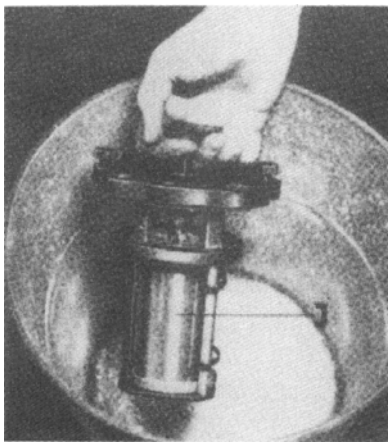
2. Shut-off feed; release the sediment drain plug A and allow the sediment to flow out. Take care of sealing washer D.



3. Undo the fixing nuts F and remove the washers G.

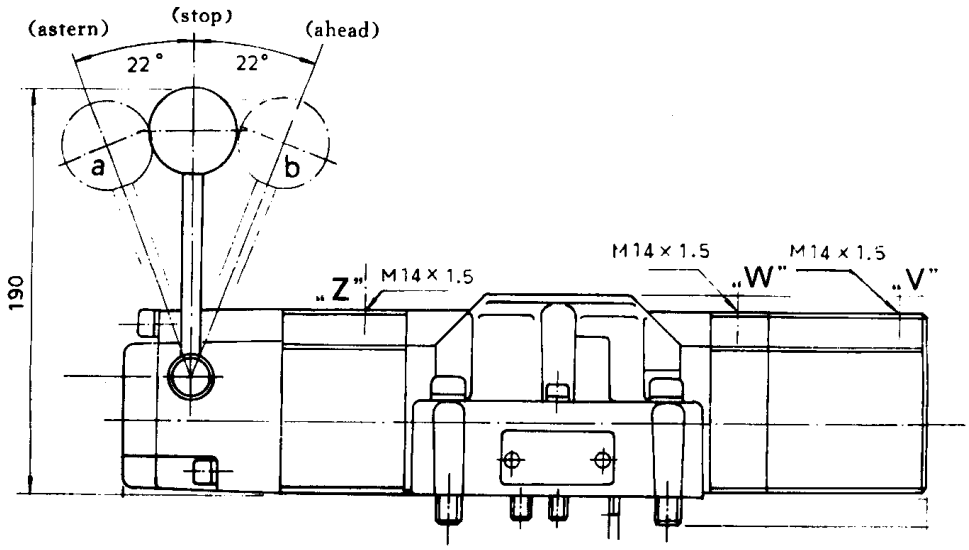
4. Lift the filter element carfully from the housing L and take care of seal

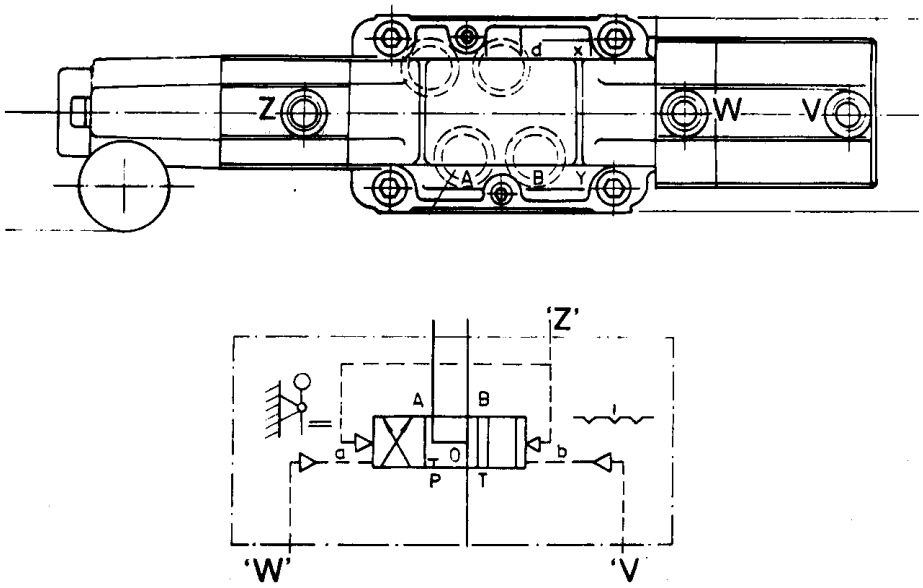
5. Clean the filter element J in washing petrol and dry with compressed-air. Do not damage the coil or cleaning brushes.



4. Pneumatic controller

Gearbox controller with by air return device





Pneumatic controller is a 3-position and 4-way valve, its control air pressure is 0.5～1MPa. The connection “Z” is always with air pressure, and the connections “V” and “W” are connected with the valve which set in control air piping.

Control principing:

Stop position: The “V”、”W” are opened into the atmosphere via the control valve. With the air pressure acting in “Z”, the pneumatic controller is in the neutral position and the working oil is cut off, “A” + “B” with “T” are connected with oil sump. Both ahead and astern clutches are disengaged.

Ahead position: Compressed air comes into “V” via the control valve, and pushes the controller moving left, the working oil enters “A”, ahead clutch is engaged.

Astern: Compressed air comes into “W”, and pushes the controller moving right, the working oil enters “B”, astern clutch is engaged.

Hand control:

When without air pressure, hand control is available to realize exchanging of ahead-stop-astern.

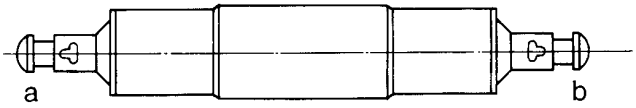
Control air piping connections:

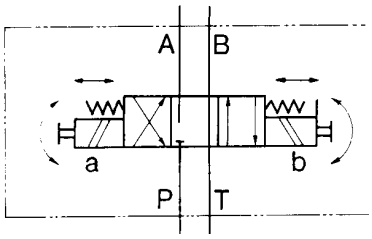
V—to control air piping valve (ahead) M14×1.5

W—to control air piping valve (astern) M14×1.5

Z—to compressed air (stop) M14×1.5

5. Electrical controller





The gearbox can also be controlled with electrical solenoid valve. The valve is a 3-position and 4-way valve.

Voltage: D.C.24V

The voltage permissible fluctuation ≤15%

I_{max} = 0.94A

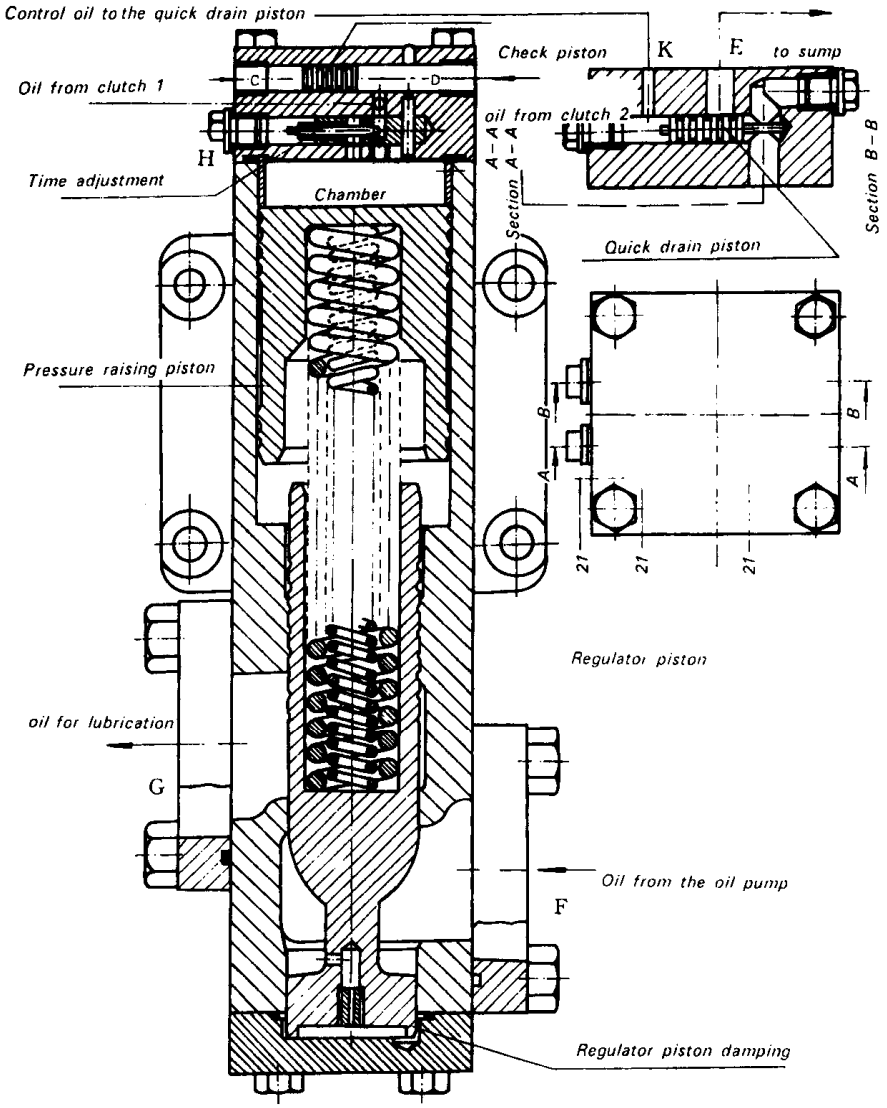
On the both sides of the valve there are mechanic hand bottoms, which can be used for the emergency controlling in case of that electricity is cut off.

When the electrical control buttom turns to the “Ahead” or “Astern” position, the relevant solenoid has electricity, pushes the valve moving and makes the working oil enter the corresponding clutch for engaging.

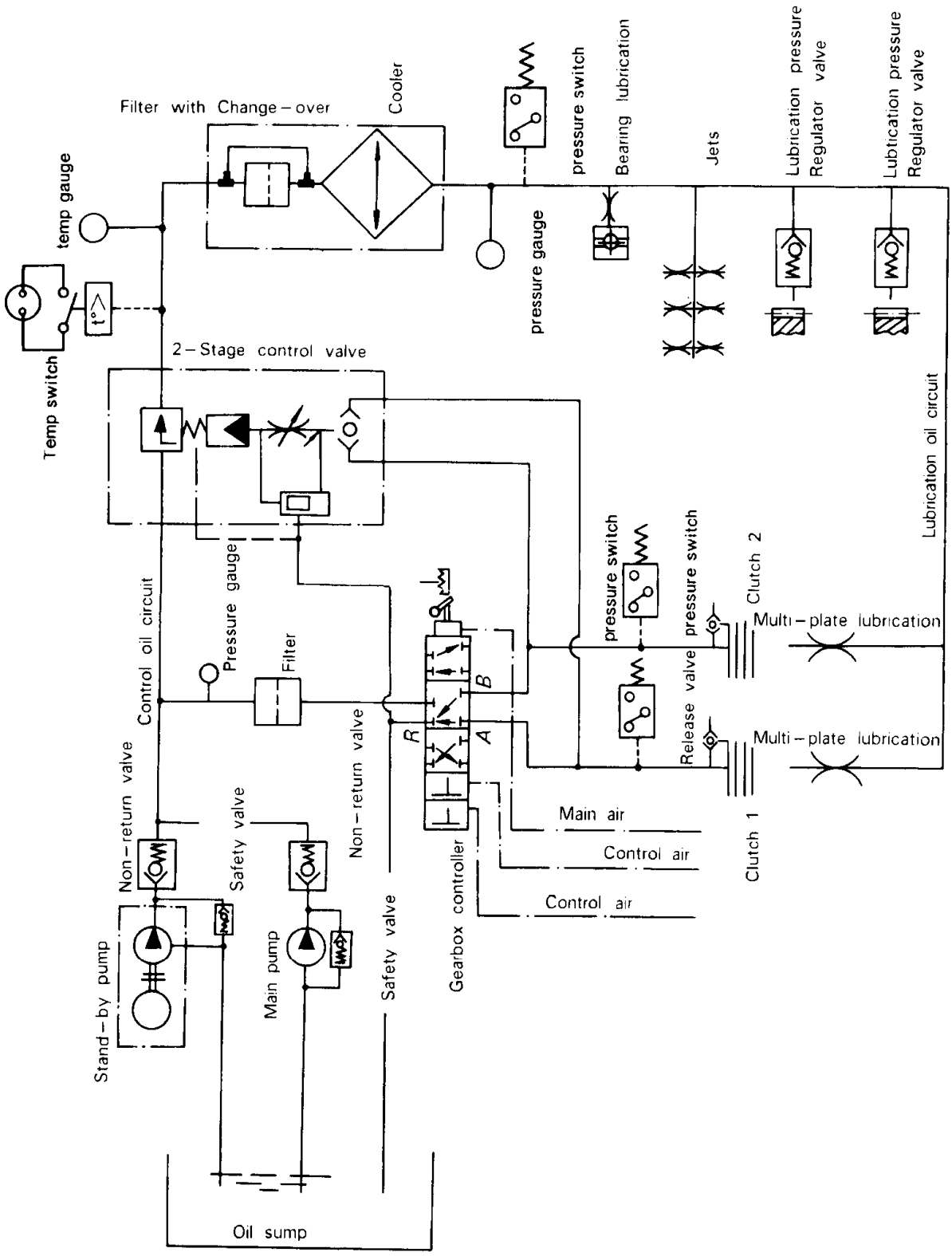
When the control buttom is in the “stop” position, both two solenoids have no electricity and the ahead and astern clutches are all disengaged.

6. 2-stage control valve

Control and lubrication oil circuit*



Control and lubrication oil circuit



2-stage Control valve description

Idling of the gearbox. Clutch not engaged.

The gearbox selector is in the stop position.

The clutches 1 and 2 are connected via the gearbox selector connections A+B with the return flow R, to the gearbox oil sump.

The connections C+D of the 2-stage valve are also pressureless and connected via the clutch connections on the gearbox selector A+B with R and the oil sump. The same happens to connection E of the 2-stage valve.

Oil from the oil pump flows to the 2-stage valve via connection “F” to connection “G”.

In this selector position the connections “C”, “D” and “E” are pressureless and it is the spring assembly which is lightly stressed and produces the pre-pressure.

After the 2-stage valve the oil comes into the lubrication oil circuit.

Engaging the gearbox. Clutch engaged.

When operating the gearbox selector the connection “A” (or “B”) is connected with the clutch 1 (or 2). The connection “C” (or “D”) of the 2-stage valve is likewise with the connection “A” connected. Thereby, ol reaches the clutch and 2-stage valve at the same time.

The oil which enters connection “C” (D) moves the checking piston in the direction of connection “D” (C).

The checking piston serves to separate the clutches 1+2, the function being like that of a double return valve. The oil from connection “C” (D) reaches the time adjustment “H”. The time adjustment consists of the receiving hole with jet needle and the chamber. Screwing in the jet needle (clockwise) makes the pressure build-up time longer.

Unscrewing the jet needle (ant-clockwise) shortens the pressure build-up time.

Attention! See control times. The given control time must be adhered to. Not

conforming to these times can lead to multiple plate damage.

The oil that flows via the time adjustment “H” into the chamber actuates the pressure raising piston, which the spring assembly strongly stresses.

Through this measure the pressure rises before the regulator piston and therefore in the complete clutch operating system.

At the same time the remaining oil at the time adjustment “H” flows via the connection “K” passed the quick drain piston and thereby blocking return flow “E”.

Disengaging the clutch

The connections are the same as in “idling of the Gearbox”. However, draining of the chamber is additionally required. Through cessation of the pressure at connection “K” the quick drain piston is not held in position.

Because of the return force of the spring assembly via the pressure raising piston on the oil in the chamber the quick drain piston rises and the oil flows to the oil sump.

Because of this, the 2-stage valve is also suitable for high control frequencies.

Drain period-max. 1 sec.

Pressure adjustment

1. The 2-stage control valve is adjusted in the works.

A re-adjustment is normally not necessary.

2. Adjustment ring: The pre-pressure of the valve is adjusted by this ring.

Lengthening the ring = raising pre-pressure

Shortening the ring = lowering pre-pressure

3. Adjustment washer: The final pressure is adjusted by this washer = Clutch control pressure is adjusted.

(Normally, no adjustment washer is provided!)

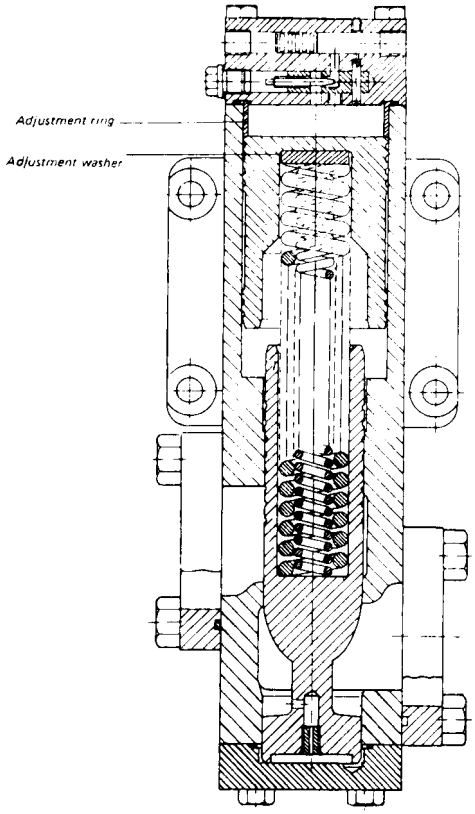
Adding or strengthening of the washer produces a rise in the final pressure.

Removing or making thinner, respectively shortening the spring reduces the final pressure.

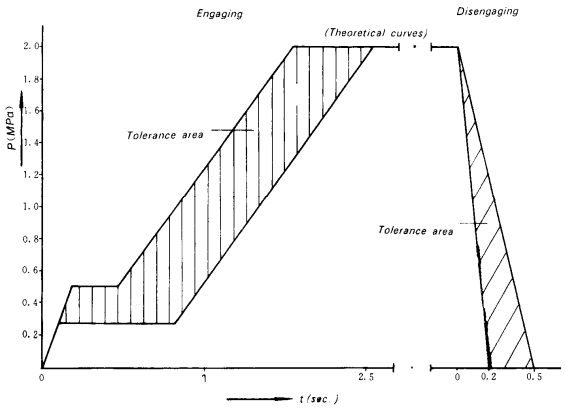
4. Ascertain the control pressure at operating temperature and nominal speed. Check when idling and with cold gearbox.

5. For values see Control and Lubrication Oil Pressures.

2-Stage Control Valve pressure adjustment



Pressure-time relationship in the clutch control pipeline after the gearbox controller, during engaging and disengaging phases.

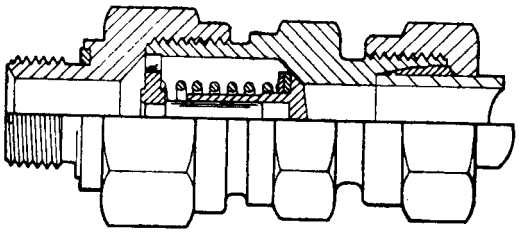


The illustration shown is valid for operation at nominal speed and operating temperature.

7. Lubrication pressure regulator valve

Characteristics:

Sealing by a 90° cone sealing washer made from rubber.

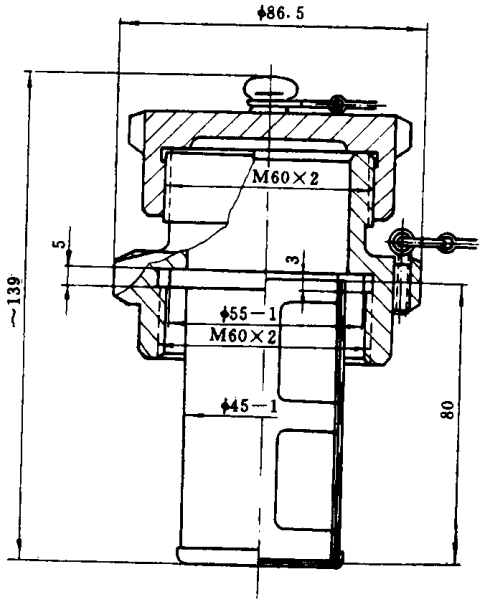


Restricted stroke, therefore, ensures free opening, shock absorbing and silent.

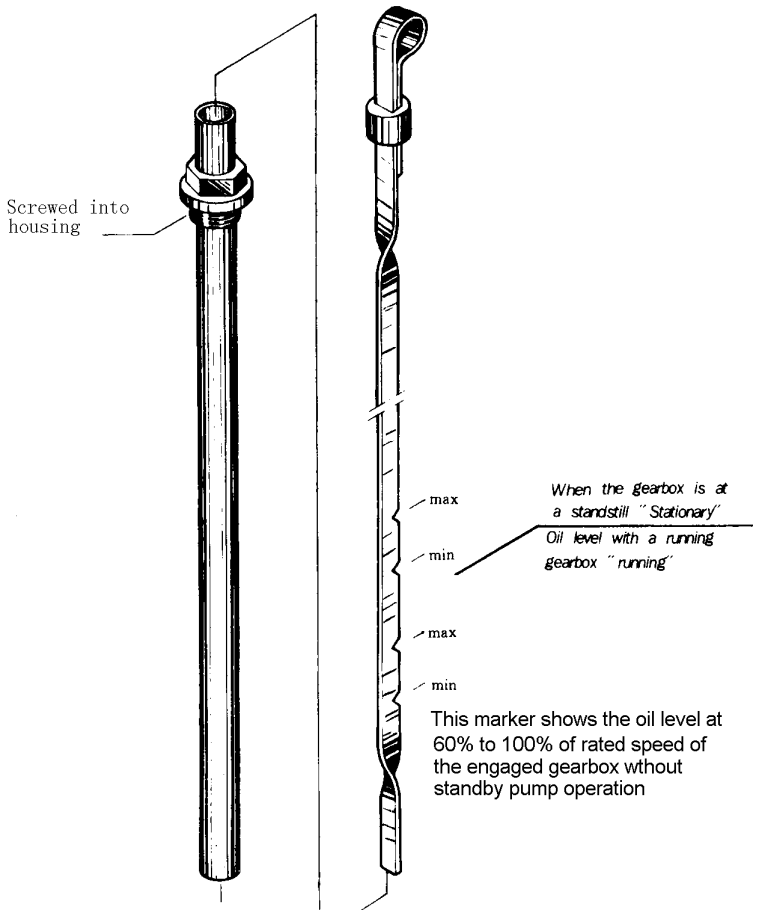
Opening pressure: Approximately 0.1Mpa.

8. Oil filler neck with sieve

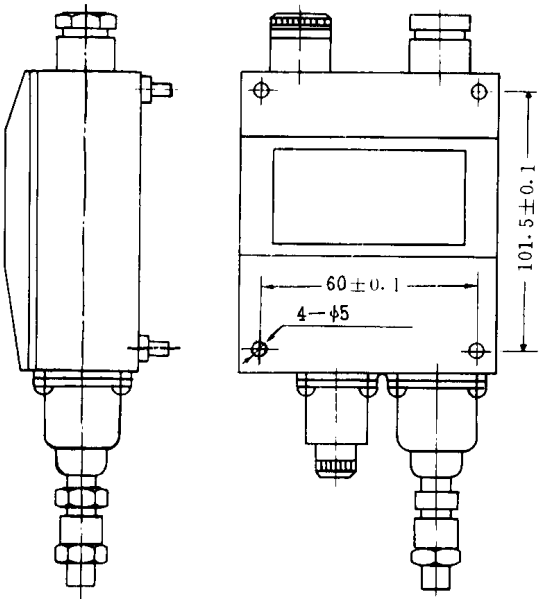
Sieve as above measurements with 3-4mm mesh size



9. Dipstick


Screwed into housing
max
min
max
min
When the gearbox is at a standstill "Stationary"
Oil level with a running gearbox "running"
This marker shows the oil level at 60% to 100% of rated speed of the engaged gearbox wthout standby pump operation

10. Pressure Switch



Type: YWK50 – C, aluminum casting case, water-resistant; untivibration acc. To standard GB5010-85

Wiring:

Double pole mini switch, working process:

Terminal 1, 2 and 3:

When the pressure lowers to the

shift point, terminal 1 has connected with terminal 3, and terminal 1 and terminal 2 are disconnected.

Electrical cable: Φ12 marine class or Φ7.5, 3-core.

Shift point:

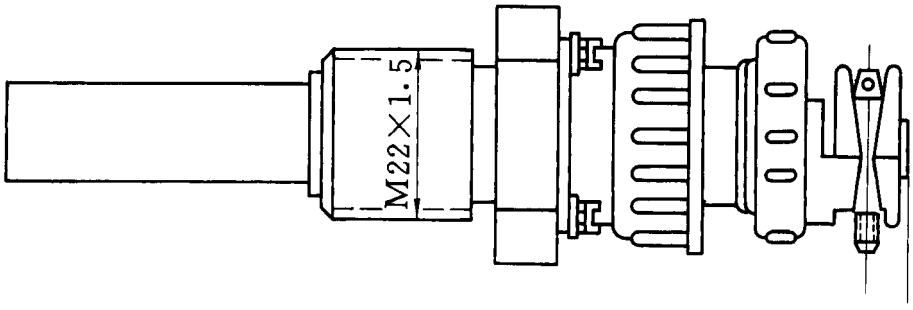
Ahead: 1.5Mpa

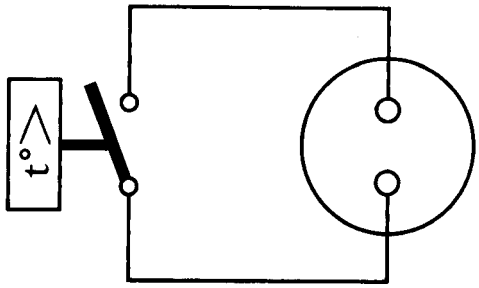
Astern: 1.5Mpa

Lubrication oil: 0.04Mpa

11. Temperature Switch

Type JWC-K-A





1. Working Voltage: D.C. 27～110V

2. Charge on the contact point: 2A (resistance)

3. Shift temp. regulated value: 72～75℃

4. Wring type: normally open.

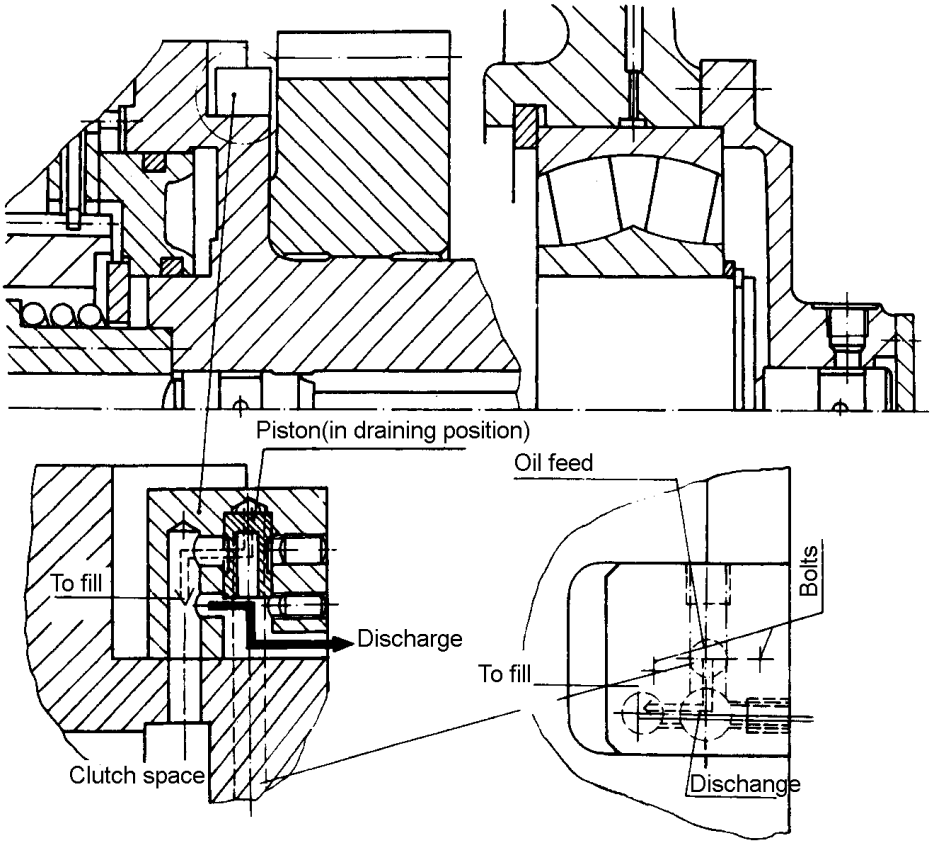
When the temperature reaches at 72～75℃, the switch is on.

12. Clutch release valve

The release valve has the task of putting the clutch into a renewed working phase as quickly as possible after being disengaged.

After the disengagement of the clutch, the retaining pressure on the piston is removed and by centrifugal and spring force the piston is put into the limiting position.

The clutch space is then discharged into the gearbox.



13. Notes:

If the structure or type of these standard accessories should be modified, the manual will be corrected in new issue.

Ⅷ. Gear selection information

Gear selection

The gear model selection based on rating, input speed and required radio is made from rating diagrams on the manual.

Ordering date

When ordering please state: gear specification, reduction ratio, design number, i.e.: Marine reverse reduction gear GWC42.45, reduction ratio i = 3, design No, B02 and the following data:

Engine maker:

Engine type:

Engine output:

Input speed: (Engine speed)

Output speed: (Propeller speed)

Direction of engine rotation: facing flywheel

Direction of propeller rotation: facing flywheel

Control valve type:

Cooling water temperature (inlet):

Classification society:

Kind of survey:

Shipyard:

Yard no:

Special order, contact the maker.

Precise reduction ratios GWC/GWL

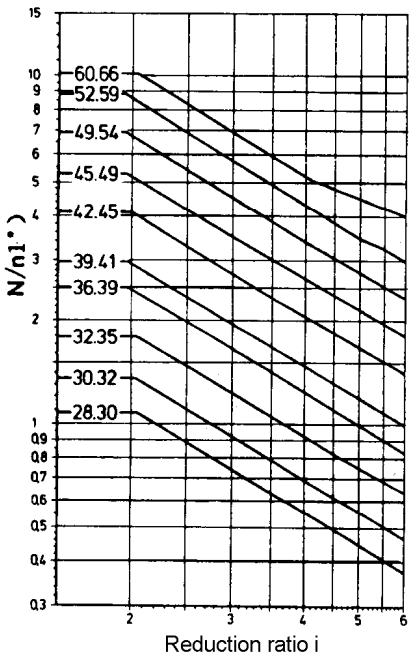
gear model	2	2.5	3	nominal reduction ratios 3.5 precise reduction ratios	4	4.5	5	5.5	6
GW28.30	2,0607	2,5053	3,0800	3,5353	4,0526	4,6457	5,0917	5,5861	6,1369
GW30.32	2,0317	2,5517	3,0370	3,5200	4,0000	4,5455	5,0476	5,6410	6,054
GW32.35	2,0585	2,5414	3,0210	3,5760	4,0526	4,5930	5,0893	5,5723	6,0789
GW36.39	1,9737	2,4502	2,9791	3,4737	3,9474	4,3958	5,0065	5,4656	5,9744
GW39.41	1,9750	2,5339	3,0632	3,5206	4,0420	4,5280	5,0935	5,5960	6,1573
GW42.45	2,0000	2,5454	3,0244	3,5788	4,0000	4,4706	5,0000	5,6000	5,9310
GW45.49	1,9737	2,4671	2,8947	3,3835	3,9474	4,3741	4,8496	5,3828	5,9847
GW49.54	1,9359	2,4592	2,9173	3,4457	3,9524	4,5336	4,9105	5,4824	5,9966
GW52.59	1,9343	2,4817	2,9643	3,5251	3,9524	4,4314	4,9725	5,4017	5,9286
GW60.66	2,0476	2,6061	3,0714	3,5833	4,0952	4,6804	5,1190	5,6040	6,1428

Precise reduction ratios GWD/GWS/GWK/GWH

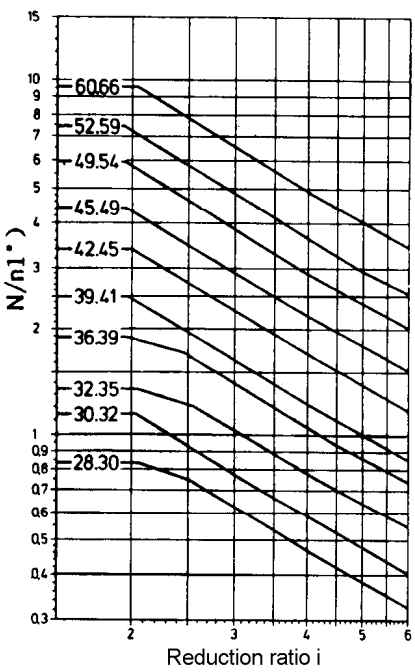
gear model	nominal reduction ratios 2	2.5	3 precise reduction ratios	3.5	4
GW28.30	2,0000	2,5556	3,0000	3,5714	4,0526
GW30.32	1,9688	2,5185	2,9583	3,5238	4,000
GW32.35	2,000	2,5556	3,0000	3,5714	4,0526
GW36.39	2,0323	2,4815	2,9167	3,4762	3,9474
GW39.41	2,0000	2,5357	2,9600	3,5000	3,9500
GW42.45	1,9730	2,5484	2,9286	3,5833	4,0000
GW45.49	2,0323	2,4815	3,0870	3,4762	3,9474
GW49.54	1,9714	2,4667	3,0000	3,5217	3,9524
GW52.59	1,9714	2,4667	3,0000	3,5217	3,9524
GW60.66	1,9722	2,4516	2,9630	3,4583	4,0952

Selection diagram GWC/GWL*

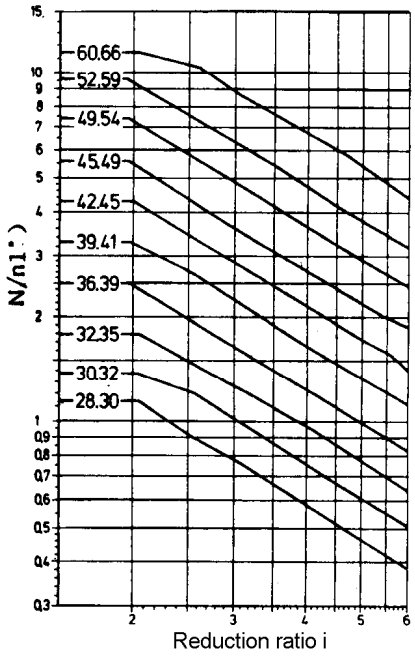
Class ABS



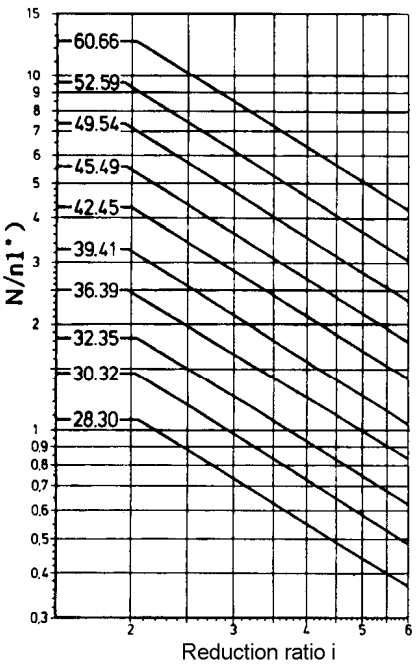
Class BV



Class GL



Class LROS



Maximum permissible input speed

Gear model	reduction ratios 2:1	2.5:1	3:1	3.5:1	4-6:1
	r/min				
28.30-36.39	900	1125	1350	1580	1800
39.41-42.45	800	1000	1200	1400	1600
45.49	700	875	1050	1230	1400
49.54-60.66	600	750	900	1050	1200

Remarks

* N = rated power, in HP (metric)

n_1 = input speed in rpm

The selection curves are based on following conditions

- the above mentioned input speeds are not to be exceeded.

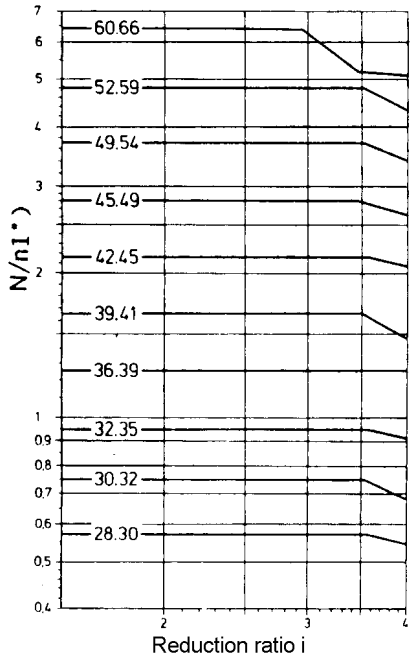
special order on request.

- inline engines with more than 5 cylinders
- Veeline engines with more than 6 cylinders
- engine and gearbox to be connected by hihgly elastic coupling

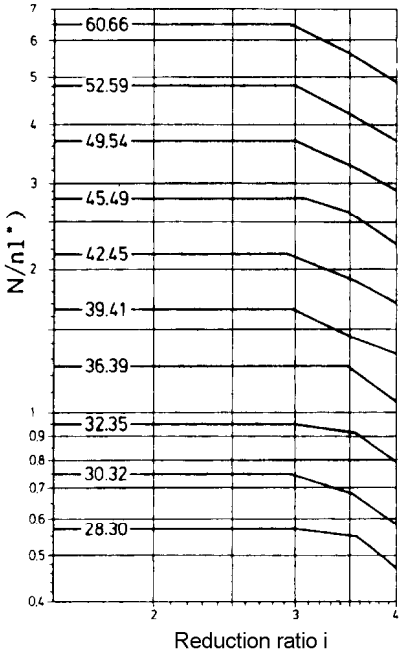
(In case of different conditiones Please contact us.)

Selection diagram GWD/GWS/GWK/GWH*

Class ABS



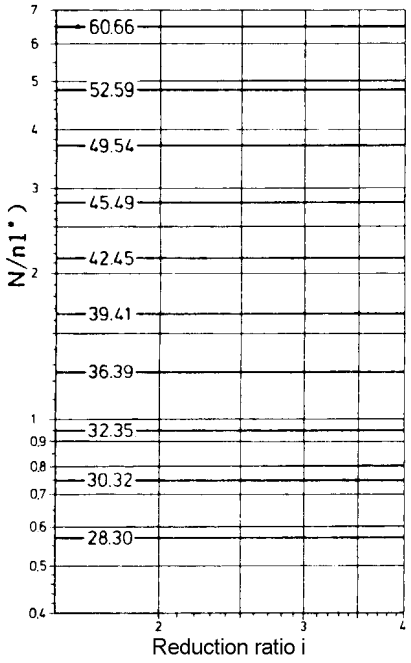
Class BV



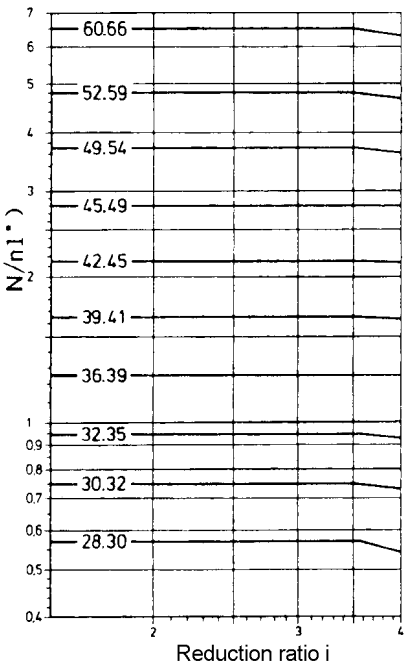
Maximum permissible input speeds

gear models	r/min
28.30	1800
30.32	1800
32.35	1800
36.39	1800
39.41	1600
42.45	1600
45.49	1400
49.54	1200
52.59	1200
60.66	1200

Class GL



Class LROS



Remarks

* N = rated power in HP (metric)

n_1 = input speed in rpm

The selection curves are based on following conditions

- the above mentioned input speeds are not to be exceeded.

special order on request.

- inline engines with more than 5 cylinders
- and vee engines with more than 6 cylinders
- engine and gearbox to be connected by hihgly elastic coupling

(In case of different conditiones Please contact us.)

Oil capacities

Gear model	Type GWC GWL GWD i = 2.6	 GWS GWK i = 2.4
	Oil capacity in ltrs.	
GW28.30	40	56
GW30.32	57	80
GW32.35	61	95
GW36.39	79	120
GW39.41	124	161
GW42.45	146	180
GW45.49	183	240
GW49.54	250	318
GW52.59	335	432
GW60.66	475	665

1) With GWS and GWK gears having ratios above 4:1, oil capacities are on request.

Cooling water requirements

Gear model	type GWC i = 2 – 6	 GWL i = 2 – 6	 GWD i = 2 – 4	 GWS i = 2 – 4	 GWK i = 2 – 4
			m^3/h/cooling water requirement in cbm/h		
GW28.30	3.0	2.5	2.8	2.8	2.5
GW30.32	3.6	2.5	3.6	3.6	2.5
GW32.35	5.0	3.6	4.1	4.1	3.4
GW36.39	5.1	4.1	4.6	4.5	3.6
GW39.41	6.2	4.8	5.0	5.0	4.0
GW42.45	7.5	6.0	5.1	5.1	5.1
GW45.49	10.2	7.5	8.9	8.9	7.3
GW49.54	13.2	10.0	10.2	10.2	8.9
GW52.59	14.0	13.0	12.5	12.5	10.2
GW60.66	14.6	13.0	13.2	13.2	13.0

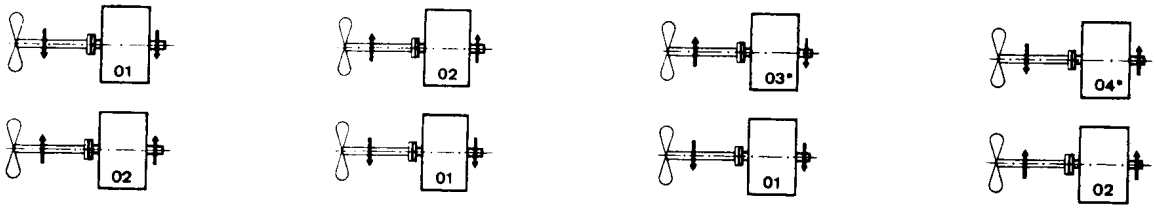
Cooler selection based on:

Water inlet temperature (max): 32℃

Oil cooler inlet temperature (max): 65℃

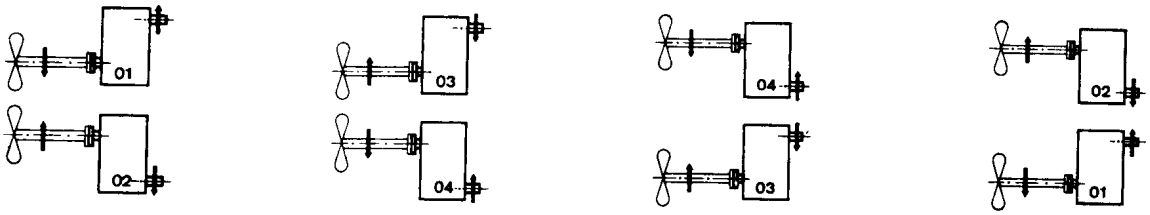
Water pressure at cooler inlet (max): 0.6Mpa

Configurations and rotations GWC/GWL[1]

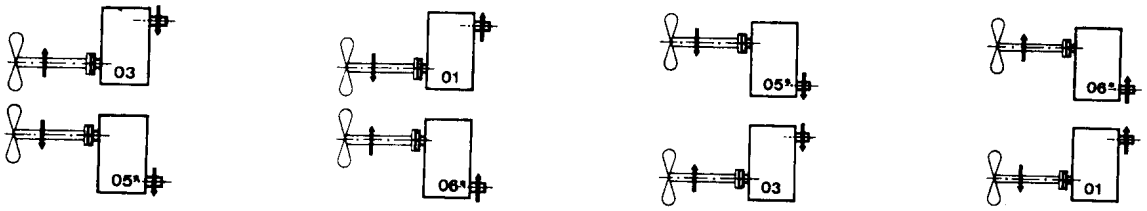


version A　version B　version C　version D

configurations and rotations GWD/GWH[1]

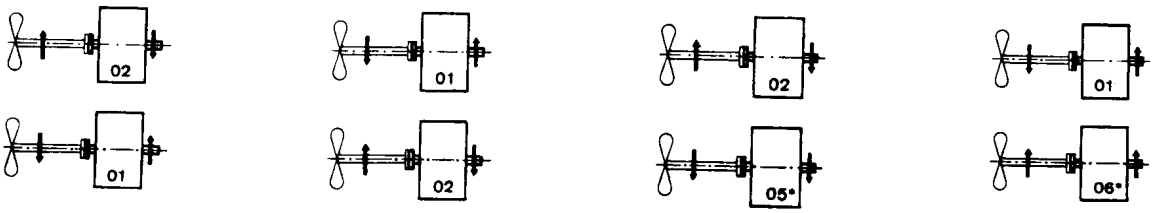


version E　version F　version G　version H



version I　version K　version L　version M

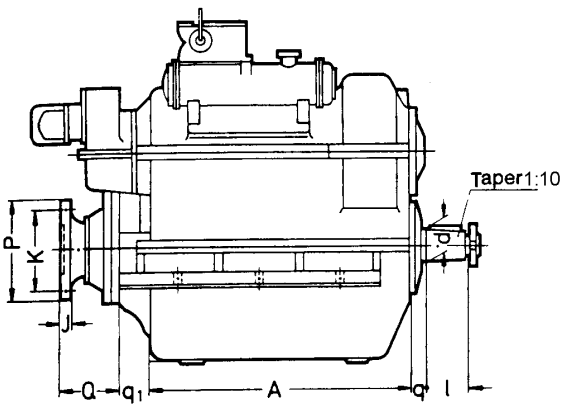
configurations and rotations GWS/GWK[1]

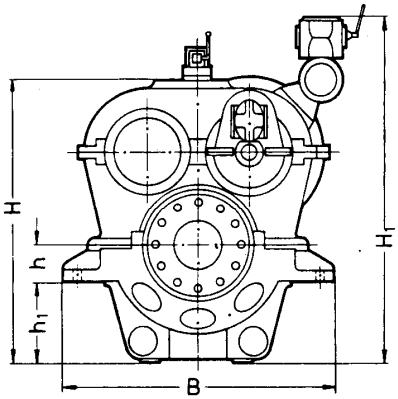


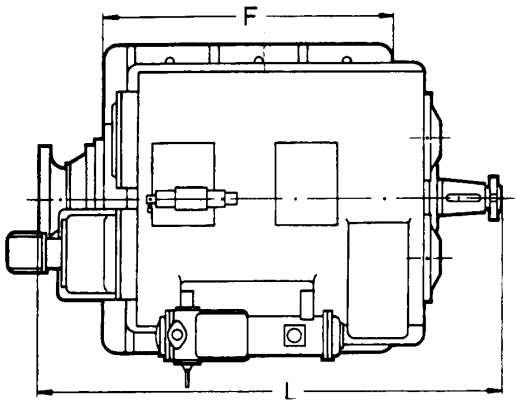
version N　version O　version P　version Q

1) Rotations stated refer to ahead movement facing engine flywheel

*) Available as special design for models GWK, GWD, GWS and GWH only.





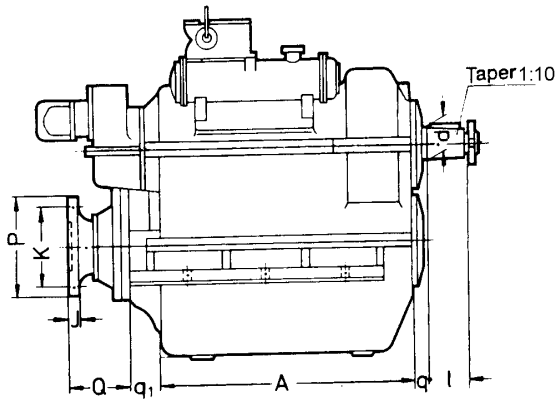


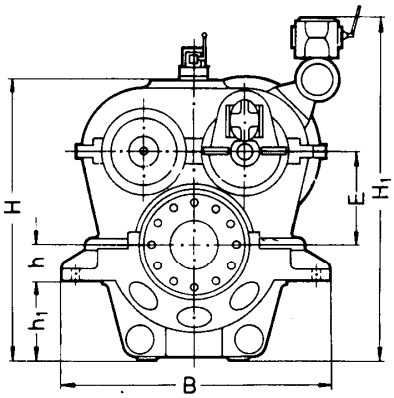
GWC = reverse reduction gear

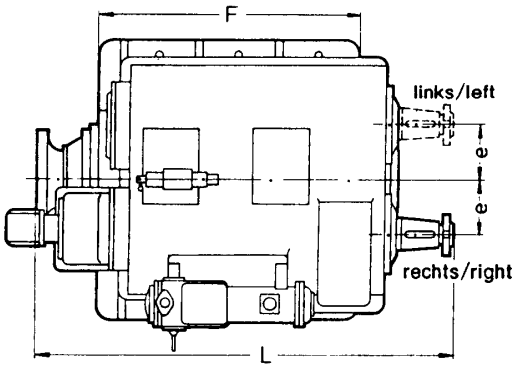
GWL = reduction gear with clutch

dimensions table i = 2:1 up to 6:1

	input				output				casing							weight with cooler	
gear model	d	I	q	k	J	P	Q	q_1	A	B	F	H	H_1	h	h_1	L	GWC	GWL
									mm								kg	kg
GW28.30	100	125	102	250	32	300	179	–	607	800	450	840	950	100	250	1036	1230	1070
GW30.32	102	125	117	270	32	320	190	–	743	860	500	888	1298	100	260	1198	1465	1240
GW32.35	110	135	123	290	35	340	205	–	752	920	560	905	1315	120	260	1238	2035	1780
GW36.39	125	150	123	300	40	360	238	–	789	1060	600	1005	1500	120	300	1326	2450	2140
GW39.41	135	163	120	330	45	400	227	–	913	1010	650	1065	1425	130	320	1454	3245	2820
GW42.45	145	180	131	400	46	470	198	–	946	1180	700	1162	1650	140	335	1486	3975	3470
GW45.49	160	200	168	420	58	500	272	–	1015	1230	710	1280	1710	150	410	1688	5275	4600
GW49.54	165	205	172	440	65	530	301	–	1072	1340	870	1390	1925	170	430	1783	6954	6000
GW52.59	195	240	200	460	70	550	250	319	1151	1400	1080	1480	2015	180	450	2198	8920	7780
GW60.66	200	250	226	500	75	600	310	370	1280	1600	1200	1670	2215	200	500	2445	12100	10550





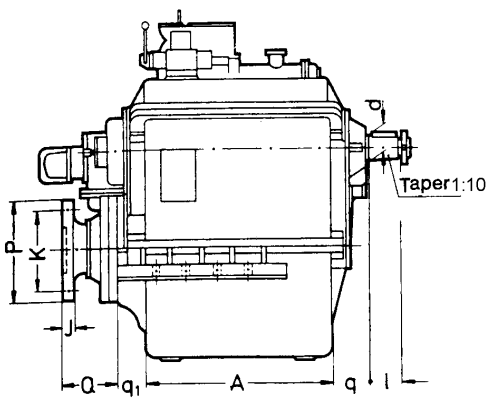


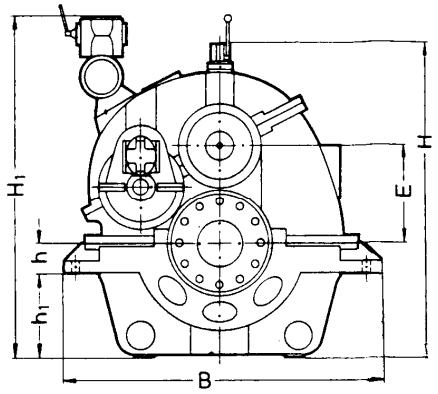
Input shaft optionally left or right
reverse reduction gear GWD

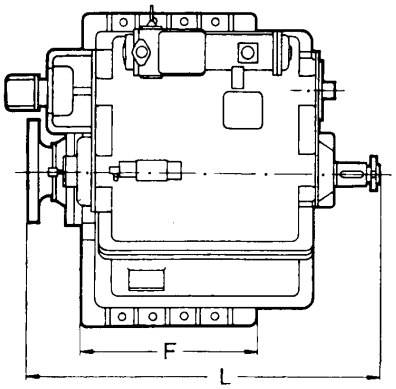
dimensions table i = 2:1 up to 4:1 *) only

	input		output						casing									weight with cooler	
gear model	d	I	q	k	J	P	Q	q_1	A	B	E	e	F	H	H_1	h	h_1	L	
									mm										kg
GW28.30	82	100	102	250	32	300	179	–	607	800	265	140	450	840	950	100	250	971	1130
GW30.32	85	105	117	270	32	320	190	–	743	860	282	150	500	888	1298	100	260	1168	1345
GW32.35	95	115	123	290	35	340	205	–	752	920	310	1625	560	905	1315	120	260	1198	1870
GW36.39	105	130	113	300	40	360	238	–	789	1060	344	182	600	1005	1500	120	300	1251	2245
GW39.41	115	140	120	330	45	400	227	–	913	1010	360	195	650	1065	1425	130	320	1423	2960
GW42.45	130	160	131	400	46	470	198	–	946	1180	396	2125	700	1192	1625	140	335	1454	3630
GW45.49	135	165	168	420	58	500	272	–	1015	1230	435	225	710	1280	1710	150	410	1649	4835
GW49.54	145	180	172	440	65	530	301	–	1072	1340	480	2475	870	1390	1925	170	430	1756	6310
GW52.59	155	190	200	460	70	550	250	319	1151	1400	528	2625	1080	1480	2015	180	450	2341	8175
GW60.66	180	225	226	500	75	600	310	370	1280	1600	587	300	1200	1670	2215	200	500	2410	11100

*) Dimensions and weights for gears with reduction above 4:1 are on request







GWS = reverse reduction gear

GWK = reduction gear with clutch

dimensions table i = 2:1 up to 4:1only

gear model	input		output						casing								weight with cooler		
	d	I	q	k	J	P	Q	q_1	A	B	E	F	H	H_1	h	h_1	L	GWS	GWK
									mm									kg	kg
GW28.30	82	100	134	250	32	300	174	–	557	1050	300	450	1020	1370	100	235	968	1230	1130
GW30.32	85	105	149	270	32	320	191	–	680	1110	320	500	1070	1420	100	250	1143	1465	1300
GW32.35	95	115	147	290	35	340	190	–	718	1200	350	560	1140	1480	120	260	1189	2035	1870
GW36.39	105	130	169	300	40	360	218	–	718	1330	390	600	1240	1580	120	290	1256	2245	2245
GW39.41	115	140	182	330	45	400	227	–	821	1400	410	650	1290	1630	130	320	1393	3230	2960
GW42.45	130	160	189	400	46	470	198	–	848	1460	455	700	1290	1630	140	335	1425	3960	3630
GW45.49	135	165	194	420	58	500	272	–	934	1590	490	710	1420	1860	150	410	1594	5275	3835
GW49.54	145	180	214	440	65	530	301	–	960	1750	540	870	1690	2130	170	470	1684	6900	6310
GW52.59	155	190	220	460	70	550	250	319	1036	1870	590	1080	1750	2320	180	480	2038	8920	8120
GW60.66	180	225	254	500	75	600	310	370	1146	2080	660	1200	1950	2520	200	500	2340	12100	11100

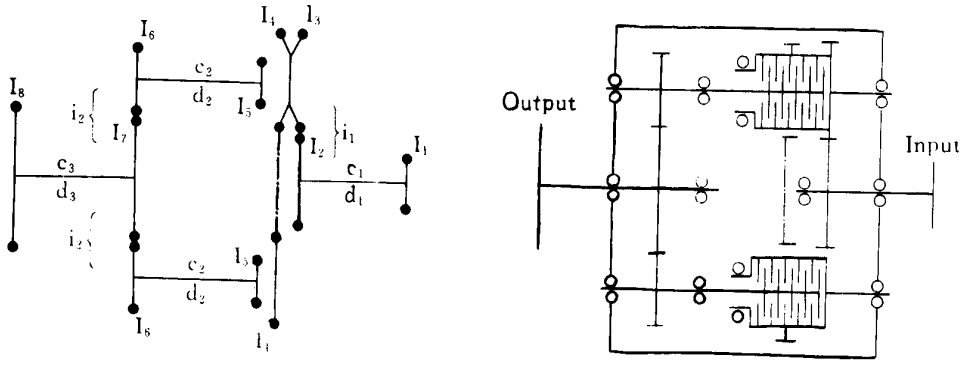
*) Dimensions and weights for gears with reduction above 4:1 are on request

Data for vibration calculation

Each system including the auxiliary system driven by the power-take-off (PTO) must be calculated regarding the torsional vibrations.

The following table contains all necessary data for GWC calculation for reference.

The data for other series and variations will be made available on request.



Vibration scheme of GWC marine gearbox

Moments of inertia

I_1 part of input shaft without coupling

I_2 input wheel with part of input shaft

I_3 Clutch wheel

I_4 turning wheel with clutch disks external

I_5 clutch disks internal with part of pinion shaft

I_6 shaft pinion

I_7 output wheel with part of shaft

I_8 output flange with part of shaft

Torsional rigidity

C_1 input shaft

C_2 shaft pinion

C_3 output shaft

gear model	ratio			moment of inertia								torsional rigidity 1)			shaft diameters 2)		
	i1 × i2	i1	i2	I1	I2	I3	I4	I5	I6	I7	I8	C1	C2	C3	d1	d2	d3
						kg·m^2						10^6Nm/rad				mm	
GWC28/30	2	0.568	4.050	0.015	1.127	0.067	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	2.5	0.618	4.050	0.015	0.864	0.113	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	3	0.760	4.050	0.015	0.605	0.180	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	3.5	0.872	4.050	0.015	0.484	0.245	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	4	1.000	4.050	0.015	0.384	0.322	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	4.5	1.119	4.050	0.015	0.328	0.420	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	5	1.256	4.050	0.015	0.259	0.498	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	5.5	1.342	4.050	0.015	0.239	0.585	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
	6	1.472	4.050	0.015	0.203	0.683	0.739	0.073	0.033	5.425	0.298	2.872	1.551	12.16	100	79/31	130
GWC30/32	2	0.508	4.000	0.022	2.089	0.103	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	2.5	0.638	4.000	0.022	1.735	0.189	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	3	0.759	4.000	0.022	1.329	0.292	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	3.5	0.880	4.000	0.022	0.994	0.421	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	4	1.000	4.000	0.022	0.792	0.511	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	4.5	1.136	4.000	0.022	0.601	0.699	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	5	1.262	4.000	0.022	0.484	0.833	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	5.5	1.410	4.000	0.022	0.367	0.943	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
	6	1.514	4.000	0.022	0.293	1.041	1.217	0.162	0.045	8.110	0.369	3.986	1.621	17.14	102	82/31	150
GWC32/35	2	0.508	4.052	0.030	2.712	0.149	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	2.5	0.627	4.052	0.030	2.176	0.276	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	3	0.745	4.052	0.030	1.468	0.422	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	3.5	0.882	4.052	0.030	1.288	0.617	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	4	1.000	4.052	0.030	1.020	0.803	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	4.5	1.133	4.052	0.030	0.793	1.026	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	5	1.256	4.052	0.030	0.660	1.293	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	5.5	1.375	4.052	0.030	0.510	1.393	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
	6	1.500	4.052	0.030	0.408	1.608	1.699	0.194	0.087	13.05	0.434	6.550	2.238	23.58	110	87/31	160
GWC36/39	2	0.500	3.947	0.040	5.300	0.281	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	2.5	0.621	3.947	0.040	4.526	0.448	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	3	0.755	3.947	0.040	3.168	0.732	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	3.5	0.880	3.947	0.040	2.443	1.060	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	4	1.000	3.947	0.040	1.897	1.376	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	4.5	1.114	3.947	0.040	1.473	1.616	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	5	1.268	3.947	0.040	1.105	2.042	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	5.5	1.385	3.947	0.040	0.859	2.371	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
	6	1.513	3.947	0.040	0.715	2.738	2.730	0.292	0.147	21.79	0.738	10.39	2.670	35.20	125	94/37	180
GWC39/41	2	0.500	3.950	0.060	6.420	0.390	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	2.5	0.630	3.950	0.060	4.680	0.710	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	3	0.770	3.950	0.060	3.250	1.050	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	3.5	0.880	3.950	0.060	2.660	1.400	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	4	1.030	3.950	0.060	2.210	1.680	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	4.5	1.140	3.950	0.060	1.890	2.040	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	5	1.260	3.950	0.060	1.580	2.440	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	5.5	1.390	3.950	0.060	1.390	2.770	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200
	6	1.520	3.950	0.060	1.260	3.270	3.680	0.440	0.211	28.36	1.130	12.38	5.720	50.24	135	115/37	200

Gear model	Ratio			Moment of inertia								Torsional rigidity 1)			Shaft diameters 2)		
	i1 × i2	i1	i2	I1	I2	I3	I4	I5	I6	I7	I8	C1	C2	C3	d1	d2	d3
				kg·m^2								10^6Nm/rad			mm		
GWC42/45	2	0.500	4.000	0.086	7.310	0.560	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	2.5	0.636	4.000	0.086	6.400	0.800	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	3	0.756	4.000	0.086	5.930	1.570	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	3.5	0.895	4.000	0.086	4.100	2.350	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	4	1.000	4.000	0.086	3.530	2.820	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	4.5	1.118	4.000	0.086	2.820	3.470	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	5	1.250	4.000	0.086	2.350	4.270	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	5.5	1.400	4.000	0.086	1.980	5.170	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
	6	1.483	4.000	0.086	1.520	5.690	5.310	0.600	0.300	47.89	2.040	17.65	7.800	87.33	145	130/46	220
GWC45/49	2	0.500	3.947	0.146	14.55	0.849	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	2.5	0.625	3.947	0.146	10.70	1.527	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	3	0.733	3.947	0.146	8.385	2.249	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	3.5	0.857	3.947	0.146	6.486	3.197	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	4	1.000	3.947	0.146	4.953	4.414	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	4.5	1.108	3.947	0.146	4.109	5.398	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	5	1.229	3.947	0.146	3.392	6.537	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	5.5	1.364	3.947	0.146	2.788	7.846	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
	6	1.516	3.947	0.146	2.284	9.342	6.746	0.861	0.382	65.56	3.241	20.27	7.510	86.72	160	127/50	240
GWC49/54	2	0.489	3.952	0.173	24.63	1.500	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	2.5	0.622	3.952	0.173	17.68	2.500	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	3	0.738	3.952	0.173	13.52	3.980	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	3.5	0.872	3.952	0.173	10.61	5.680	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	4	1.000	3.952	0.173	8.760	7.940	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	4.5	1.147	3.952	0.173	6.090	9.780	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	5	1.242	3.952	0.173	5.430	11.92	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	5.5	1.387	3.952	0.173	4.760	14.42	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
	6	1.517	3.952	0.173	3.430	15.79	10.26	1.310	0.710	101.9	3.670	21.40	12.40	116.1	165	145/51	260
GWC52/59	2	0.490	3.950	0.728	37.52	2.570	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	2.5	0.630	3.950	0.728	25.24	4.180	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	3	0.750	3.950	0.728	19.56	6.020	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	3.5	0.890	3.950	0.728	14.08	7.950	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	4	1.000	3.950	0.728	11.81	9.870	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	4.5	1.120	3.950	0.728	9.330	11.19	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	5	1.260	3.950	0.728	7.890	13.62	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	5.5	1.370	3.950	0.728	6.170	13.08	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247
	6	1.500	3.950	0.728	5.940	16.40	14.29	2.191	1.313	162.2	11.33	36.11	13.18	54.12	195	145/51	247

1) absolute values not reduced 2) hollow shaft